7th ANNUAL QUALITY CONTROL FEATURE ISSUE

OCTOBER, 1954

TOOLING and PRODUCTION

The Magazine of Manufacturing Management

1934 · 1954 20th ANNIVERSARY YEAR

Stand-by Plants? Why Not
nd-by Training?", editorial

•

AUTOMATIC GRINDER
transfers skills

•

STATISTICAL Q-C
in Precision Manufacture

•

V STATISTICAL ANALYZER
Simplifies Inspection & Q-C

•

ALITY IMPROVEMENT—
n at the Bird, Not the Flock

•

OLROOM MEASUREMENTS
with Contour Projector

•

NCOMING INSPECTION
and Vendor Relations

•

R GAGES & AIR GAGING

•

A GAGEMAKER'S
Q-C CONCEPT

•

GNETIC COMPARATOR

•

QUALITY CAPABILITY
of Machine Tools

•

STEEL INDUSTRY Q-C

•

URFACE PLATE FLATNESS

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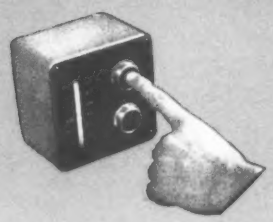
BPA

HARDINGE
ELMIRA, N.Y.

NEW Lathe with Variable Speed
for
Tool Room—Development—Production Work



Simply Push a Button for Exact Spindle Speeds

It's the **NEW** *Simplified Design*

EASY AND CONVENIENT TO OPERATE

FEATURING:

- Infinitely Variable Speeds 230 to 3500 r.p.m.
- Fast Lever Operated Collet with 1⅛" Capacity
- Hardened and Ground Steel Dovetail Bed Ways
- Patented Positive Lock Slide Rest
- Full Bearing Tailstock
- And Other Cost Cutting Features

For Complete Information on this Precision Lathe Write for Bulletin DV59

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

Don't Get Caught Without a Spindle

Be protected with a SHEFFIELD ADJUSTABLE BALLJET SPINDLE KIT against an accident, an unexpected engineering revision, an oversight in a tool order. You'll be ready, too, to gage those small runs of high precision parts.

Size Setting Gage

In 5 minutes you can assemble from the Kit a spindle for any size within a range of one to three inches and set it to size with the Size Setting Gage. Four spindles of various sizes can be placed in use simultaneously.

NO MASTER SETTING RINGS NEEDED

Standard Calibrator

To assemble and use these spindles, you need only an air gage and the equipment illustrated in the Kit plus a set of standard gage blocks—nothing else—not even one master setting ring. The air gage is calibrated by using the standard calibrator illustrated.

PLAY SAFE—have the Adjustable Spindle Kit on hand for daily use and ready for that emergency which may happen tomorrow.

Call your local Sheffield representative or write for Engineering Data Sheet 119-54. ***Gage Division, The Sheffield Corporation, Dayton 1, Ohio, U. S. A.***

6749

MASTER CRAFTSMAN SHEFFIELD HEADQUARTERS

SHEFFIELD

PUTNAM END MILLS are HIGHEST QUALITY

Highest Quality is derived from years of experience, continued dedication to functional research, pride in accomplishment and unexcelled manufacturing facilities.

Throughout the entire Putnam line of end mills (there are over 1200 standard sizes and types) you will find strong evidences of superior design and workmanship. For example: The ability of Putnam End Mills to last longer, and cut cleaner when operated at high speeds and heavy feeds on tough milling operations is indicative of their higher quality.

A trial of Putnam Quality on Your toughest milling job will surely convince.

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TOOL COMPANY
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CIRCLE INFORM-A-GRAM KEY NO. 3

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easy as

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see pages 38 & 39

REAMER BUYERS

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TOOLING and PRODUCTION

The Magazine of Manufacturing Management

formerly
Tool-Die-Machine PROGRESS 1934-1941
TOOL & DIE JOURNAL 1941-51

VOL. XX—No. 7 OCTOBER, 1954

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TOOLING and PRODUCTION'S great appeal is to those men who operate the plants and divisions of industry, their production departments and their toolrooms. It is they who collectively are charged with the responsibility of manufacturing their companies' products precisely, efficiently and profitably.

They have the influence that enables them to adopt the ideas and the processes which TOOLING and PRODUCTION describes in every issue AND the authority to recommend, to specify and/or to buy everything that may be needed to reduce costs, increase production or improve quality. These men for whom, each month, our editors seek out or write TOOLING and PRODUCTION'S meticulously accurate stories of "Know-How" and "Tell-How" are T & P's exclusive Cycle of Buying Influence (CBI) in their plants.

Every copy is directed to these men by name, by title and by company address. Please see our BPA verification.

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PUBLISHERS OF: Tooling and Production ★ Die Designing and Estimating ★ Plastics Molds
The Know-How-Library of Tooling and Production

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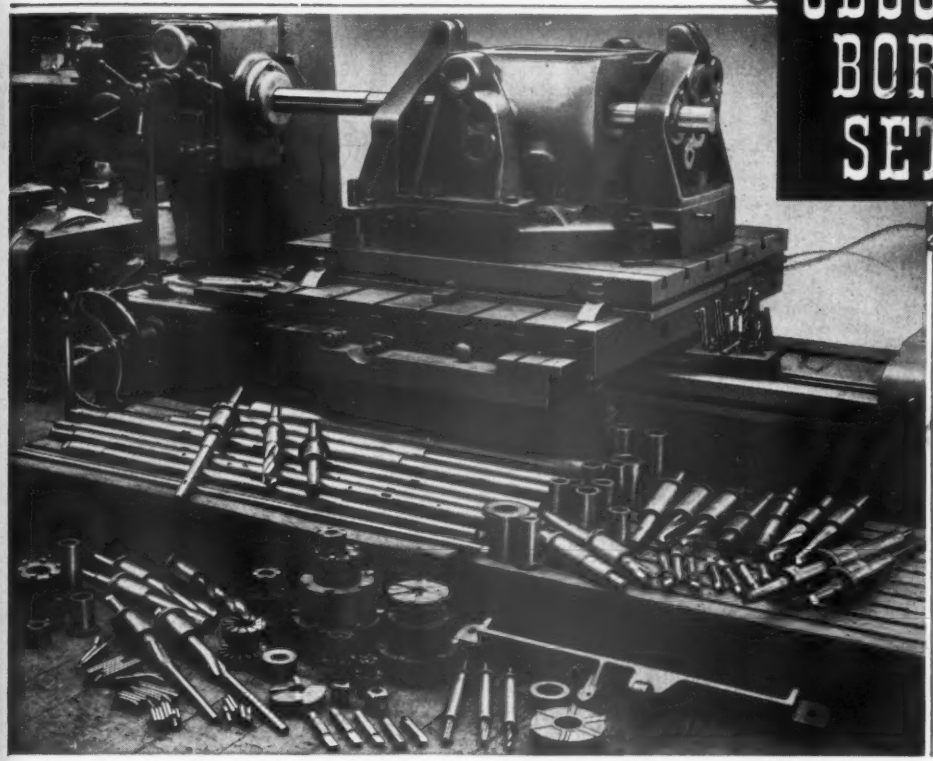
"J

Here is a picture of an...

OBSOLETE BORING SETUP!

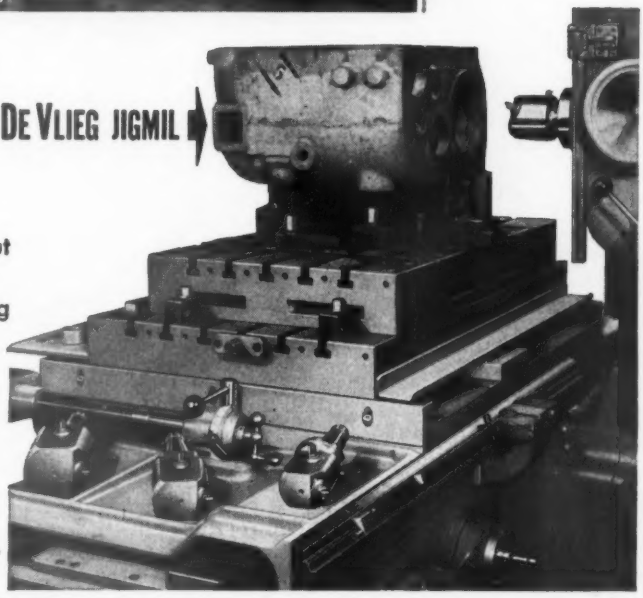


THIS PICTURE— taken in a well known machine tool plant illustrates the old method of boring turret lathe headstocks with a costly inflexible box jig and a mass of special tooling

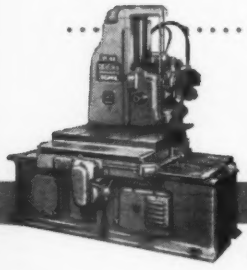
The Modern Method

"JIGLESS BORING" THE SAME PIECE ON A DE VLIEG JIGMIL

- Eliminated expensive boring jig
- Reduced machining time
- Improved accuracy with a resultant cut in assembly costs
- Permitted the use of simplified tooling



If your shop is burdened with costly boring jigs and special tooling, it will pay you to investigate the DE VLIEG SPIRAMATIC JIGMIL!



Come to Detroit... see a practical demonstration of the JIGMIL Technique . . .

DE VLIEG MACHINE CO.

A request on your company letterhead will bring a copy of our comprehensive Illustrated Catalog

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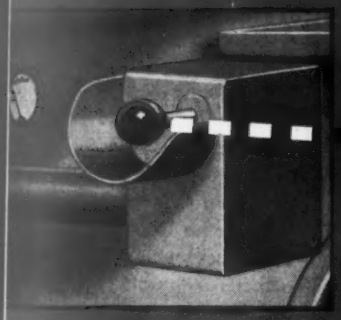
Outstanding Time Saver...
...Outstanding ACCURACY



Single Control Lever

The New Cincinnati Magnetic Clutch and Brake, with its single, convenient control lever, gives the operator the fastest, simplest and most accurate control of his Shaper and converts waste time into productive time.

This powerful clutch and brake requires no adjustment, and has a long, maintenance-free life.

Write for Cincinnati Shaper Catalog N-6.

30% Time Saving

Shaping time on 7 internal oil grooves in these steel sleeves was reduced from 12 minutes to 8 minutes, by the Cincinnati Electro-Magnetic Clutch and Brake.

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO, U.S.A. SHAPERS • SHEARS • BRAKES

you'll be glad you switched to **BALAS**

Smooth Feeding
Long Lasting
Stock Saving

Balas PUSHERS

You'll see an immediate improvement both in quality and in continuous money-saving operation resulting from the proper use of Balas Feed Fingers and Master Pushers. Selected tool steel, accurately machined, carefully heat-treated and thoroughly inspected guarantees proper tension and smooth feeding.

Balas Pushers have made remarkable records on long runs...turning out millions of pieces without breaking down on the job. They help you make more profit on your production line and reduce stock waste at the same time. Difficult feeding jobs and scratchless operations are readily handled with the correct Balas Feed Finger or Master Pusher. Order from our large stock of standard types and sizes. You'll make more ...you'll save more with Balas!

THE BALAS LINE INCLUDES

- Master Collets and Pads
- Pushers and Feed Fingers
- Master Pushers and Pads
- Ejector Collets
- Collet Sleeves and Chuck Nuts for B.&S. Machines
- Carbide faced Stock Stops for B.&S. Machines

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CLEVELAND 14, OHIO

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We Built a Reputation...

PRATT & WHITNEY KELLER

Automatic Tracer-Controlled Milling MACHINES

are now FASTER, MORE EFFICIENT than ever before

With a work area of 36" x 20", the Type BL Keller is ideal for a wide variety of smaller jobs. Both single and 3-spindle models are manufactured. Other Keller Machines accommodate practically any required work size up to 20 feet horizontally by 7 feet vertically.

"KELLERING" *means...*

Throughout industry, use of the P&W KELLER MACHINE to produce complex 2- and 3-dimensional forms by tracer-controlled milling has become so popular and so widespread that this type of machining is universally known as "Kellering."

Yes, we at Pratt & Whitney are proud of this recognition and reputation. But we also know that reputation and past performance ***alone*** aren't enough to insure ***your*** continued profitable operation in the face of increasingly competitive markets and constantly rising production costs.

For this reason, we have carried on a program of continuous research, development and improvement. As a result, P&W Keller Machines — always outstanding performers — now offer the increased speeds, feeds and inbuilt efficiency to meet today's demands for still greater productivity. In many applications, actual on-the-job performance has proved that Keller Machines are ***now more than twice as fast*** as older machines or older methods.

- **FAST, ECONOMICAL REPRODUCTION OF COMPLEX SHAPES . . .** that cannot be machined economically by any other means.

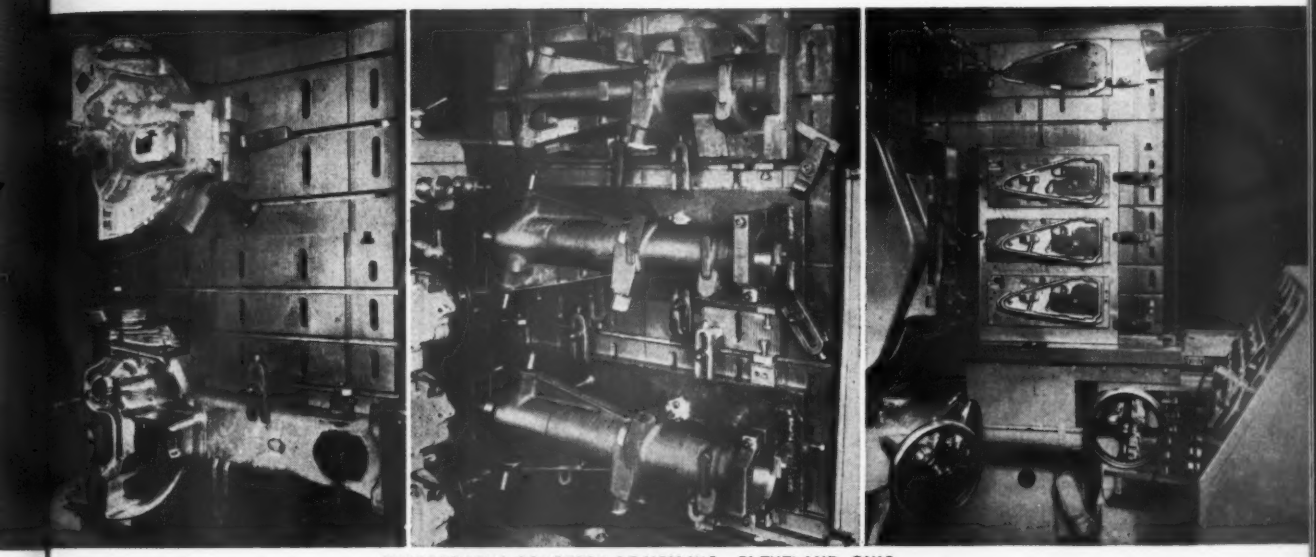
- **AN UNLIMITED VARIETY OF JOBS WITHOUT EXPENSIVE ATTACHMENTS . . .** because P&W Keller Machines are designed and built *specifically* for tracer-controlled milling, not just adapted.

- **RUGGED DEPENDABILITY . . .** Kellers stay on the job year after year without frequent or expensive maintenance.

- **ELECTRIC TRACER CONTROL . . .** that is dependable, relatively simple, retains high initial accuracy without complicated adjustment. ***Profiling*** to a pre-set depth following an outline template . . . or ***3-dimensional milling*** following a full model.

. . but We're Not Resting on it!

ALL THESE JOBS . . . DONE QUICKER, BETTER



PHOTOGRAPHS COURTESY OF MPM INC., CLEVELAND, OHIO.

DIES, MOLDS AND METAL PATTERNS

The complex 3-dimensional shape of a plaster model is duplicated in a large brass casting to produce a pattern for a railroad coupling. Using only one of its 3 spindles, the Keller Machine easily accommodates this large workpiece.

PROTOTYPE AND PILOT PRODUCTION

Producing parts for aircraft landing gear, this P&W Keller Machine mills two steel forgings simultaneously. The exact shape of the mahogany model shown at the top is accurately duplicated with speed and economy.

PRODUCTION MILLING AND PROFILING

Precision profiling 3 aluminum alloy castings at a time, this P&W Keller 3-Spindle Machine economically makes production runs on aircraft ribs. The model, in this case, is an inexpensive, 2-dimensional steel template.

Maintaining Your Reputation

. . . and your profits demands constant progress and improvement with a well conceived program of replacement and modernization. Plan to include ***new*** P&W Keller Machines in your program . . . benefit by the added productivity they can bring to today's *and* tomorrow's jobs. Write to the P&W Branch Office nearest you . . . or direct to West Hartford . . . for your free copy of Circular No. 490-3 that fully describes the Type BL Keller Machine.

MODERNIZE with PRATT & WHITNEY REPLACE FOR PROFIT

PRATT & WHITNEY

DIVISION NILES-BEMENT-POND COMPANY

WEST HARTFORD 1, CONNECTICUT, U. S. A.

SINCE 1860

First Choice P&W *for Accuracy*

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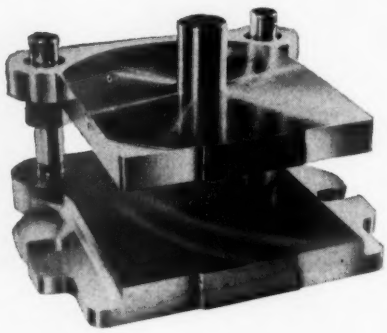
MACHINE TOOLS • CUTTING TOOLS • GAGES

Fastest die set service ever



. . . made possible by Danly's unique mass-production and distribution system.

At the main Danly plant . . . high speed precision drilling. Interchangeable fixtures accommodate the full range of standard die set sizes.

At your Danly Branch plant . . . shipping die sets to your order. Up-to-date procedures and facilities assure fastest delivery.

To make your tooling program move faster, Danly mass produces interchangeable, precision die set parts . . . stocks them at your local Danly Branch ready for quick assembly to your order and delivery to you. With Danly, from the time you place your order until the set is delivered to you is a matter of only a few days. This extra fast delivery starts at the main Danly plant in Chicago where two complete high-speed production lines turn out a wide variety of precision die set parts. Held in ample stock by your local Danly Branch, these interchangeable parts are assembled to your order and delivered immediately. Don't let lagging die set delivery bog down *your* tooling program. Order from your Danly Branch and get the fastest service . . . ever.

DANLY

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2100 South Laramie Avenue
Chicago 50, Illinois

Fast, nationwide delivery from these branch plants

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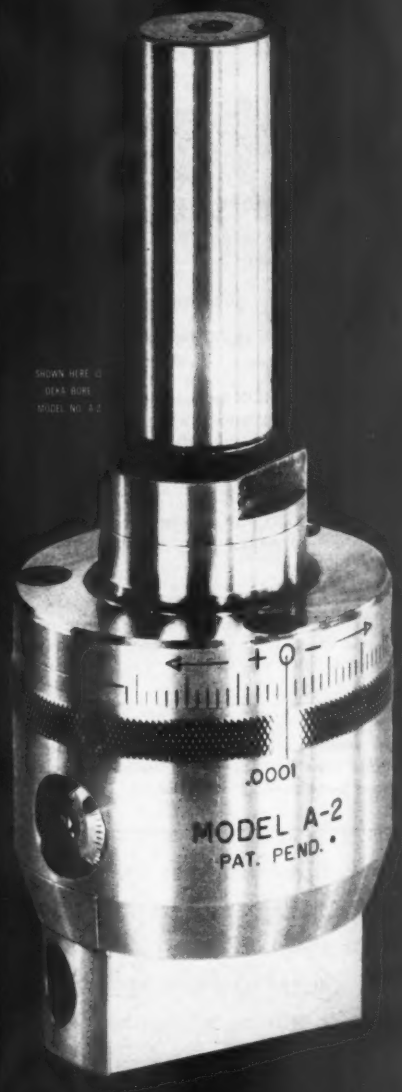
*CLEVELAND 14	1650 East 33rd Street
*DAYTON 7	3196 Delphos Avenue
*DETROIT 16	1640 Temple Avenue
*GRAND RAPIDS	113 Michigan Street N.W.
INDIANAPOLIS 4	5 West 10th Street
*LONG ISLAND CITY 1	47-28 37th Street
*LOS ANGELES 54	Ducommun Metals & Supply Co. 4890 South Alameda
MILWAUKEE 2	111 East Wisconsin Avenue
*PHILADELPHIA 40	311 W. Courtland Street
*ROCHESTER 6	33 Rutter Street

*Indicates complete stock

save
80% of
boring time
with

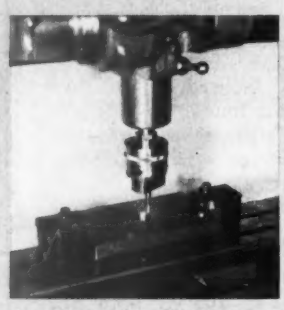


- Two independent Means of Adjustment:
  1—Conventional Micrometer Screw Adjustment for increments of .001.
  2—Direct reading, **with naked eye, dial adjustment for increments of .0001 on diameter .00005 on radii.**
- Absolutely guaranteed to calibrate accurately and consistently. No backlash.
- Can be used in fixed or rotating applications, adaptable to any type of production or Tool Room equipment.
- All parts heat treated and ground. Hi-Alloy steels assure years of trouble-free service.

DEKA BORE

The only boring head with direct reading dial adjustment for increments of .0001 on diameter and .00005 on radii!

DEKA BORE is a cost saver on both long production runs and single piece work in jig boring. Its extreme close tolerance adjustment is perfect for the precision demands of automation and any type of precision boring. Most important of all, DEKA BORE **assures the quality of your finished products.**
You can make adjustments in fractions of 1/10,000 of an inch, on the full diameter, as easily as reading 1/16 of an inch on a steel rule. This is **not** a vernier or scroll adjustment. You can calibrate the DEKA BORE in increments of .00005 on radii or .0001 on diameter as easily as picking up .002 on a conventional micrometer dial. DEKA BORE IS 100% GUARANTEED TO GIVE YOU YEARS OF TROUBLE FREE USE. It has no parts to wear out, or go out of adjustment. DEKA BORE can be equipped with your choice of shanks at extra cost.



SPECIFICATIONS MODEL A-2

Body diameter	2⅛"
Body length	3⅝"
Bar or tool capacity	½"
Tool Block slide	1½"W x 2⅝"L
Maximum Offset	½"
Bar or tool grip	1⅜"
Back threaded	⅛"–14
Weight	4¼ lbs.

▲ On this operation DEKA BORE saved 80% of the time previously spent on the same job. DEKA BORE is shown being used here on a vertical milling machine.

PRECISION TOOL & MFG. COMPANY OF ILL.
1905 SOUTH LARAMIE, CICERO 50, ILLINOIS

LET US DEMONSTRATE DEKA BORE IN YOUR PLANT, AT NO OBLIGATION TO YOU. WRITE NOW FOR THE NAME OF YOUR NEAREST DISTRIBUTOR OR FOR FREE LITERATURE.

Gentlemen: Please send me:
☐ the name of my nearest DEKA BORE distributor.
☐ more free literature and prices.
TP-10
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FIRM _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

CIRCLE INFORM-A-GRAM KEY NO. 11

Acid Disc Inspection backed by *Ultrasonic Testing* is just one of many Carpenter quality controls.

IF YOU USE TOOL STEEL, THESE ARE FACTS YOU SHOULD KNOW

When you make or use a tool or die you invest a sizable sum of money. And there are steps you normally take to protect your investment. You make sure the design is right. You follow through with accurate toolmaking and correct heat treating. But there is *one* factor involved in the success of your die, over which you have only indirect control. That factor is the *soundness* of the die steel you start with. After all, if the steel itself isn't right, you needlessly risk your entire investment.

How can you be *sure* the die steel you use has what it takes to assure good tools? The answer lies in the painstaking controls regularly practiced by the steel manufacturer. Listed here are the four important tool steel controls pioneered by Carpenter to give steel users like yourself the protection you need. Before you place that next tool steel order, ask yourself, "Does our steel supplier guarantee these four quality controls in the die steel we use?" Then remember: You can be *sure* of them when you specify Carpenter Matched Tool and Die Steels. And you don't pay anything extra! THE CARPENTER STEEL COMPANY, 106 W. Bern St., Reading, Pa.

4 Tool and Die Steel Developments *Pioneered by Carpenter* Help Carpenter Customers Cut Costs, Improve Die Performance

Since 1929:

HOT ACID DISC INSPECTION has been standard practice at Carpenter. To Carpenter customers it provides full assurance that Matched Tool and Die Steels are internally sound, shipment after shipment.

Since 1930:

The TOUGH TIMBRE TEST has assured Carpenter users a wider safe hardening range, greater dependability in performance.

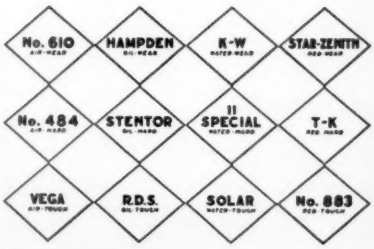
Since 1933:

The TORSION IMPACT TEST has provided Carpenter Matched Tool and Die Steel users with more complete heat treating information that leads to better tools and dies.

Since 1940:

The CONE TEST, used to check and control hardenability of Carpenter water-hardening Matched Tool and Die Steels, has made sure that sections of the same size have uniform hardness penetration in lot after lot.

Carpenter STEEL — Matched Tool and Die Steels



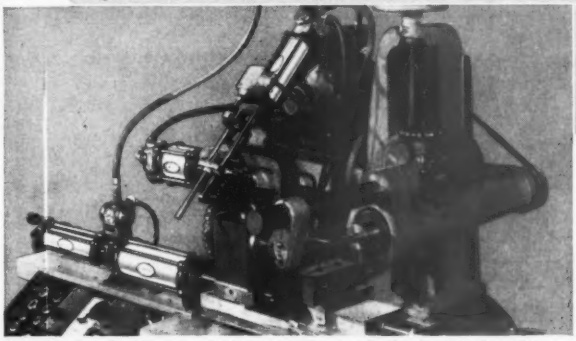
Export Department: The Carpente. Steel Co., Port Washington, N.Y.—"CARSTEELCO"

Mill-Branch Warehouses and Distributors in Principal Cities Throughout the U.S.A. and Canada

CIRCLE INFORM-A-GRAM KEY NO. 12

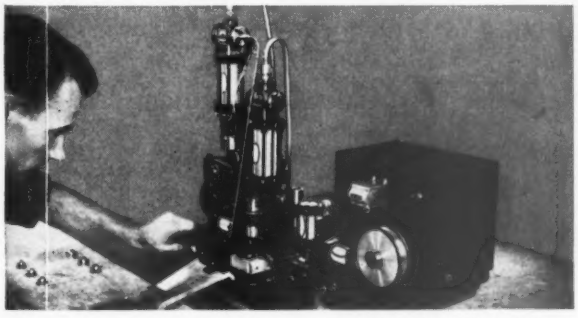
With one or more of these "packaged" power units . .

. . . you can build quickly in your own tool room special purpose, cost saving machines like these:

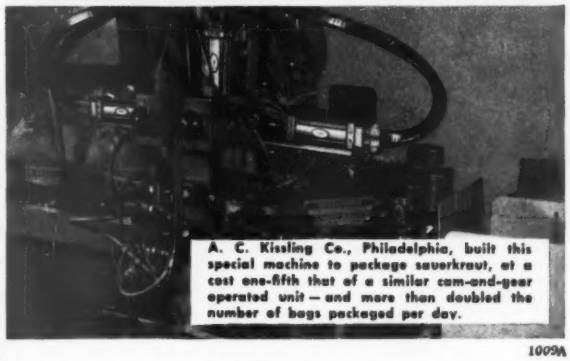


Acetogen Gas Co., Detroit, obtained a 600% production increase in milling splines for their gas cutting torch tips, with this special machine built around Bellows air equipment.

This special testing machine, built around Bellows "Controlled-Air-Power" Devices, increased production from 1,300 parts per day to 3,000 parts per day at the plant of Allis Seal Co., Chicago.



Radio Receptor Co., Inc., Brooklyn, N. Y., designed this tool-room-built cut-off and forming machine and jumped production over the old method by 350%.



A. C. Kissling Co., Philadelphia, built this special machine to package sauerkraut, at a cost one-fifth that of a similar cam-and-gear operated unit — and more than doubled the number of bags packaged per day.

1009A

The next time you get a chance, take a critical look at some of your routine operations — particularly those you've been handling the same way for the past four or five years. There are cost-savings there you shouldn't overlook.

The four illustrations on this page are typical of the ways that Bellows "Controlled-Air-Power" Devices and a little ingenuity can team up to accomplish big savings. It's worth checking into.

WRITE FOR THIS FREE 36 PAGE BOOKLET

Here in these quick-reading pages is the story of "Controlled-Air-Power" — what it is doing for others — what it can do for you. It's free on request. Dept. TP 1054, The Bellows Co., Bellows Bldg., Akron 9, Ohio. In Canada, write to: Bellows Pneumatic Devices of Canada, Ltd., Toronto

The Bellows Co.

AKRON 9, OHIO

FIELD ENGINEER OFFICES IN ALL PRINCIPAL CITIES

CIRCLE INFORM-A-GRAM KEY NO. 13

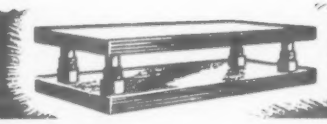
now LEMPCO

2-POST *BALL BEARING* DIE SETS

ARE PRICED DOLLAR-FOR-DOLLAR WITH

COMMERCIAL PLAIN BUSHING DIE SETS!

IMMEDIATE DELIVERY FROM STOCK.

LARGE & SPECIAL  LEMPCO BALL

BEARING DIE SETS *NOW* QUOTED AT

DRASTICALLY ***REDUCED PRICES!***

DELIVERY: Within 5 DAYS···SPECIALS, 10 DAYS.

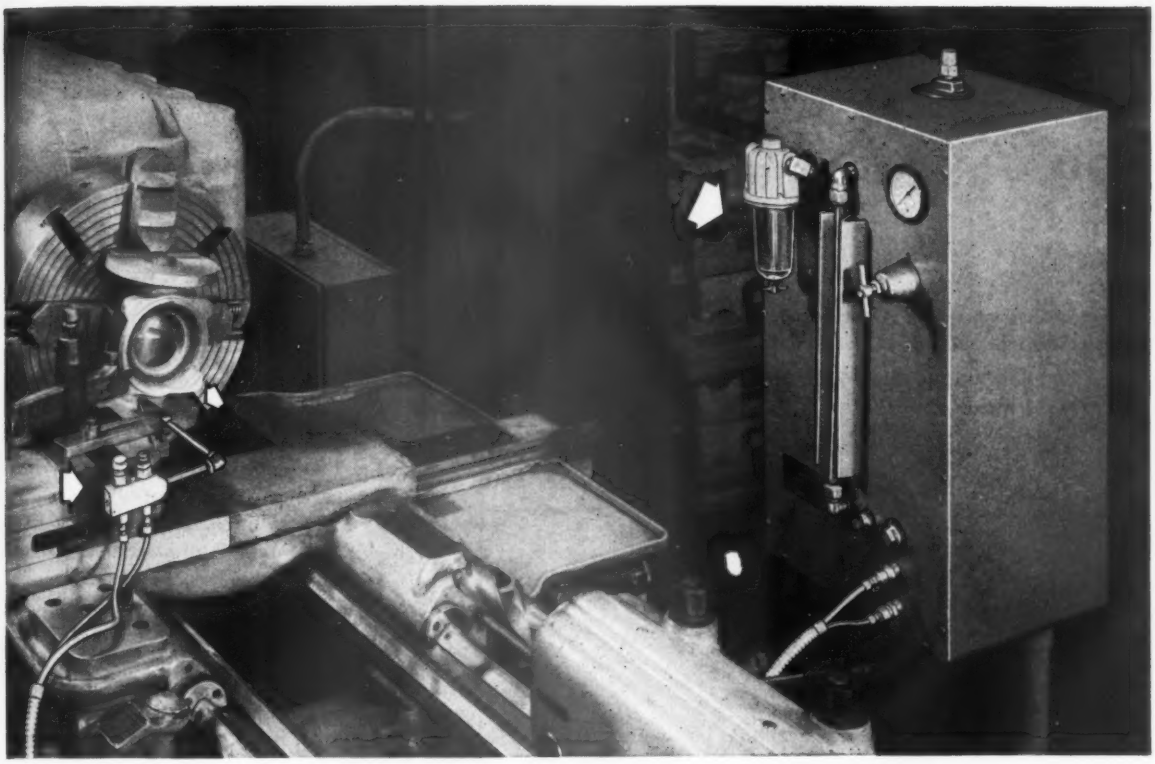
It's true; now you can buy the die sets which are known to be the best, at REGULAR prices. Famous Lempco Anti-Friction Die Sets out-perform all other makes. Save you money, time and trouble.
Lempco's rapidly growing die set VOLUME makes this price reduction possible.

WRITE FOR LEMPCO'S BIG NEW (7th Edition) CATALOG AND LATEST PRICE LIST

NOW BUY THE BEST IN DIE SETS—FOR LESS

LEMPCO PRODUCTS, INC., BEDFORD, OHIO

LEMPCO INDUSTRIAL DIVISION



LO-JET ACRO

'TURNS-OFF THE HEAT' turns-up profits and production

Lo-Jet Cools And Lubricates

Lo-Jet ACRO is a pressurized mist system that provides both evaporative cooling of tools and work, and lubrication, to reduce friction generated heat. Because it's pressurized, Lo-Jet delivers cooling and lubrication uniformly, too, regardless of operational conditions.

Lo-Jet Pays For Itself In Reduced Costs

Lo-Jet ACRO increases tool life 100%-300%, and the resultant savings in tool cost alone soon pay for the unit. The Lo-Jet costs less to operate, too.

Lo-Jet Increases Production

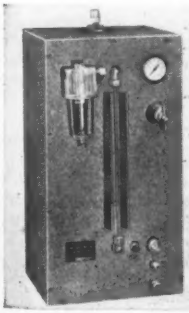
With Lo-Jet ACRO on the job, you can take heavier cuts on any work, and operate at higher feeds and speeds. And because tools last longer, there is a drastic reduction in the amount of tool-change time required.

Lo-Jet Provides Better, Cleaner, Safer Operation

The directed cooling and lubrication of Lo-Jet ACRO result in improved finishes. Lo-Jet leaves the tool and work plainly visible and clean at all times. The ACRO coolant used is fireproof, lightly pine-scented, absolutely non-toxic to humans.

Lo-Jet Is Versatile And Easy To Install

Lo-Jet ACRO is completely self-contained, and can be installed on any cutting machine in minutes! It eliminates expensive, messy pumps, sumps, and piping. It can be used in turning, grinding, milling, drilling, tapping, and reaming. It's ideal for multi-phase, high speed operations, because it can be used to control as many as six nozzles at once, with full pressure and separate controls for each tool.



Don't let your profits and production go up in smoke! Mail the coupon now for literature that tells how to improve all cutting operations with

LO-JET ACRO

AIR CONVERSION RESEARCH Corporation

3025 N. Western Avenue • Chicago 18, Illinois TP-10

GENTLEMEN: Please send me literature that fully describes the new Lo-Jet ACRO.

Name_____

Company_____

Address_____

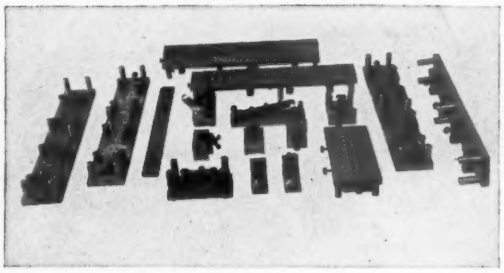
City_____ Zone____ State_____

CIRCLE INFORM-A-GRAM KEY NO. 15

YOU GET SPEED PLUS ACCURACY WITH MOORE JIG BORERS

IN THE TOOLROOM

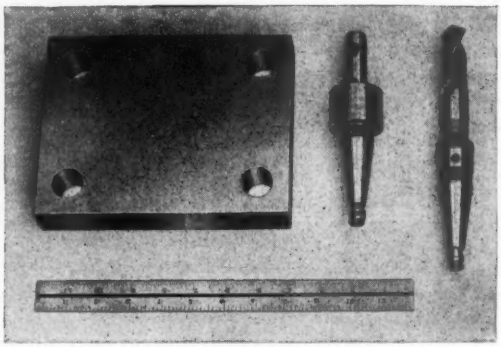
400 holes to "tenths"—5 to 7 minutes each on the No. 1 Moore Jig Borer



Manufacture of this group of drill jigs involves accurately locating, drilling and boring approximately 400 holes. The No. 1 Moore Jig Borer finished them to "tenths" in from five to seven minutes per hole.

ON PRODUCTION

64 holes to ±.0002"—2 minutes each on the No. 2 Moore Jig Borer



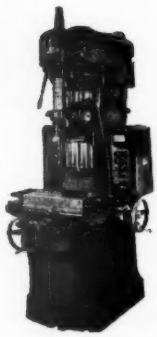
Sixteen pieces like this were located, drilled, bored and checked on a No. 2 Moore Jig Borer with one drill and one carbide bit. The 64 holes were finished in 2 hours and 8 minutes (plus 30 minutes setup) with location and size tolerances ± .0002".

Only a precision machine geared to the high American production standards of ruggedness *and* accuracy can meet these performance requirements. For versatility and speed in spotting, drilling, reaming, boring and checking operations in production as well as tooling, no other moderately-priced machine tool compares with the Moore Jig Borer. And there's no sacrifice of accuracy for speed, since the lead screw measuring system built into each Moore machine permits working to the closest of tolerances.

You'll find that the Moore Jig Borer can pay for itself—*in jig time*. Write today for detailed bulletins.

Moore Special Tool Company, Inc.
726 Union Avenue, Bridgeport 7, Conn.

NO. 1 MOORE JIG BORER
Table working surface of 10"x16". Over 1200 now in use throughout the world. The ideal small, accurate jig borer. Lead screws accurate to .0002" in 16".



NO. 2 MOORE JIG BORER
Table working surface of 10"x19". Heavier cuts, larger holes. Features infinitely variable spindle speeds, three power feed ratios, centralized control panel.

ADD MOORE TOOLS TO YOUR TOOLROOM

JIG BORERS · JIG GRINDERS · PANTO-CRUSH WHEEL DRESSERS · DIE FLIPPERS · MOTORIZED CENTERS · HOLE LOCATION ACCESSORIES

see our catalog in MACHINE TOOL CATALOGS or write for copy

CIRCLE INFORM-A-GRAM KEY NO. 16

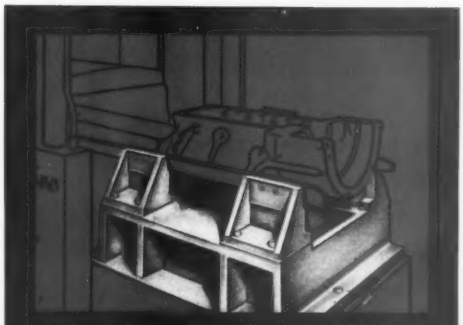
Swartz

SPECIAL FIXTURES

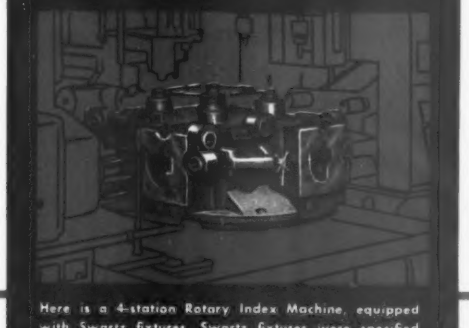
for AUTOMATIC MACHINE TOOLS

A special 14-station In-Line Transfer Machine, incorporating Swartz precision work-holding fixtures.

- **IN-LINE TRANSFER MACHINES**
- **ROTARY INDEX MACHINES**
- **TRUNNION INDEX MACHINES**
- **SINGLE-STATION MULTIPLE-OPERATION MACHINES**



Station No. 1—Special 14-station In-Line Transfer Machine. Swartz fixtures were specified for dependable, on-the-job fixture performance.



Here is a 4-station Rotary Index Machine, equipped with Swartz fixtures. Swartz fixtures were specified for maximum service and dependability.

There are many advantages in specifying Swartz precision work-holding fixtures . . . advantages which are shared alike by both buyer and builder of automatic machine tools.

Of particular importance, is the seasoned experience, and specialized know-how which Swartz has gained through more than 30 years of fixture-building service to the machine tool industry. This experience and skill, together with the modern facilities needed to do the job, make Swartz service *complete* . . . from part print to finished fixture!

There are other advantages, too, in specifying and using Swartz fixtures. It will pay you to get the facts! A Swartz engineer will be glad to discuss your fixture requirements, and point out the many ways Swartz service can work for you *profitably*.

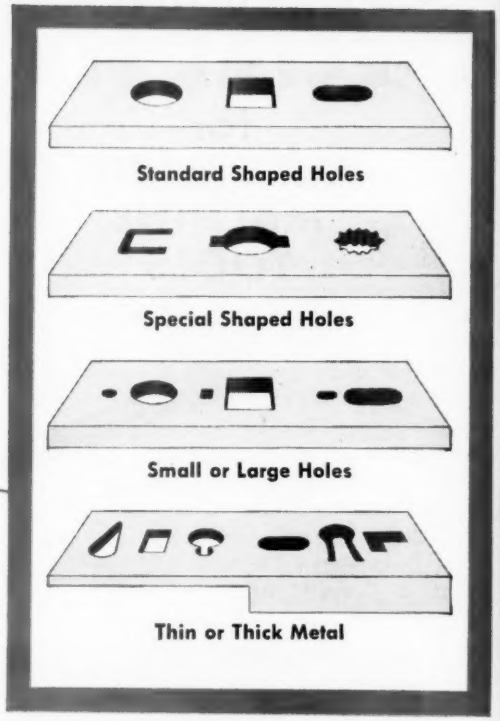
Write Today **Swartz service is outlined in this interesting new brochure, "Advancing Automation." A copy will be mailed on request.**

SWARTZ TOOL PRODUCTS
Division of Jefferson Corporation
13336 FOLEY STREET • DETROIT 27, MICHIGAN

Designers and Builders of: Pump Jigs · Standard Fixtures · Fixture Locks · Special Fixtures for Automatic Machine Tools.

CIRCLE INFORM-A-GRAM KEY NO. 17

WHEN R-B Punches Are Used

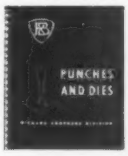


What are your piercing or forming requirements—standard or unusual shapes—small or large holes—steel or special alloys—thin or thick metals? There is either an R-B punch in standard shapes and sizes or R-B will manufacture special punches, die buttons and retainers to your specifications that will provide more efficient piercing operations.

Many hole-making applications, formerly requiring drilling or some other costly means, can now be done with R-B interchangeable punches. If you have thought your piercing jobs too tough for interchangeable punches, it will pay you to investigate the wide application potential of R-B standardized equipment.

R-B Engineering Service Is Available for Your Tough Piercing Problems.

RICHARD BROTHERS PUNCH DIVISION
ALLIED PRODUCTS CORPORATION
Dept. 73 ● 12635 Burt Rd. ● Detroit 23, Michigan



Please send me additional information.

NAME_____ TITLE_____

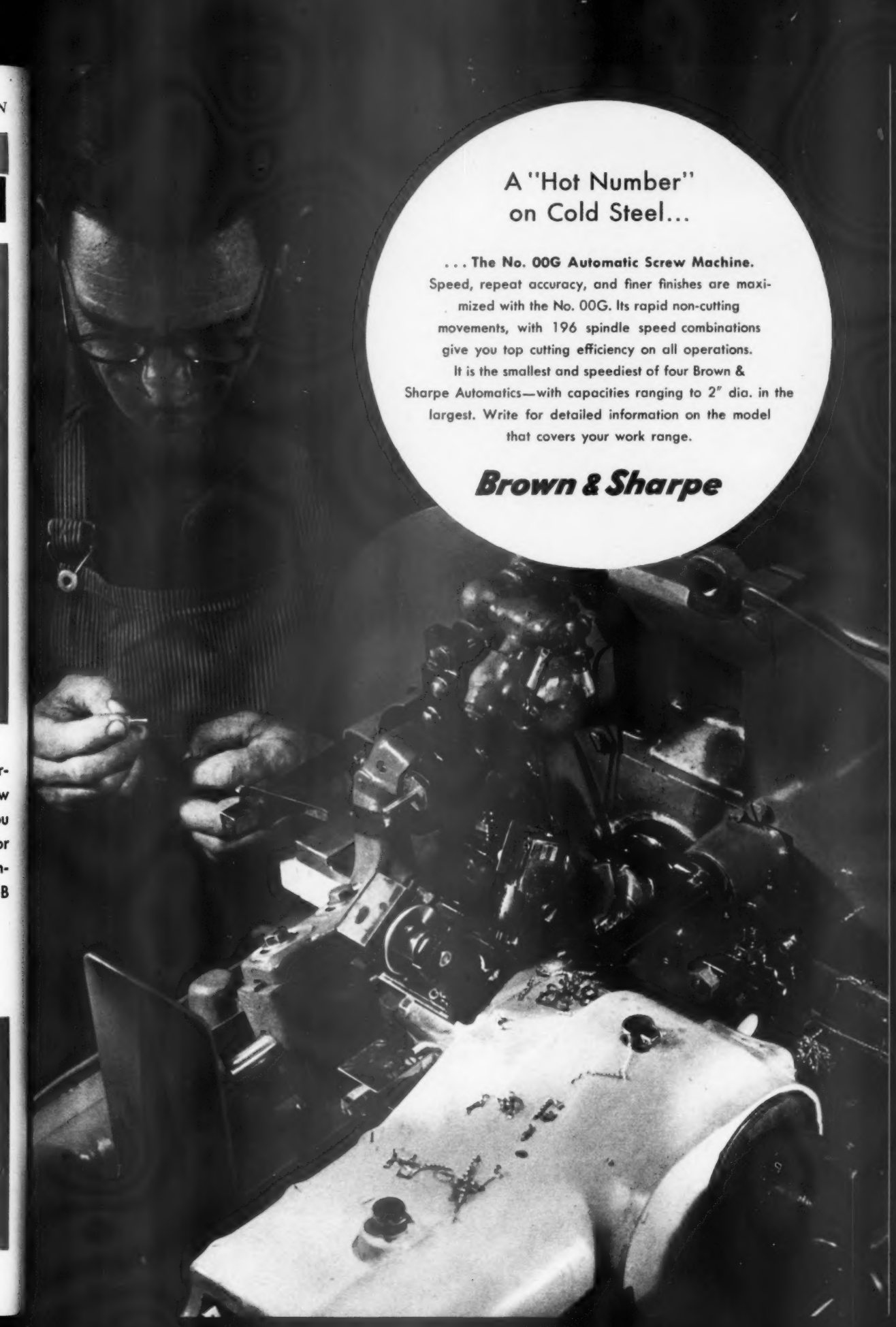
COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Also Produced in
OTHER ALLIED PLANTS
SPECIAL COLD FORGED PARTS
STANDARD CAP SCREWS
PRECISION GROUND PARTS
SHEET METAL DIES MADE OF FERROUS ALLOYS, ZINC ALLOYS OR PLASTICS

CIRCLE INFORM-A-GRAM KEY NO. 18


A "Hot Number"
on Cold Steel...
. . . The No. 00G Automatic Screw Machine.
Speed, repeat accuracy, and finer finishes are maximized with the No. 00G. Its rapid non-cutting movements, with 196 spindle speed combinations give you top cutting efficiency on all operations. It is the smallest and speediest of four Brown & Sharpe Automatics—with capacities ranging to 2" dia. in the largest. Write for detailed information on the model that covers your work range.
Brown & Sharpe

Set 'em and Forget 'em...
. . . Brown & Sharpe Screw Machine Tools.
Rigidly retain their original settings on piece after piece
. . . even on long-run jobs . . . for the closer limits and
finer finishes you require. Their simple, modern design speeds
set-ups and adjustments . . . cuts non-productive time. Get
all the facts on this line of over 500 tools for the widest variety of
screw machine jobs. Write for new catalog 35 S.
BUY THROUGH YOUR LOCAL DISTRIBUTOR
Brown & Sharpe
BROWN & SHARPE MFG. CO, PROVIDENCE 1, R. I., U.S.A.
Milling Machines • Grinding Machines • Screw Machines
Cutters • Machine Tool Accessories • Machinists' Tools
Electronic Measuring Equipment • Johansson Gage Blocks
Permanent Magnet Chucks • Pumps
Printed in U.S.A

In Jig and Fixture Components . . .

Get What You Want

With the recent addition of such new items as this heavy-duty jack with working parts of hardened-tool steel, Lodding now offers the most complete line of standard jigs and fixtures available.

STANDARDIZE

With

YOU GET THE BEST

All Lodding fixtures are carefully engineered and quality-built to provide long, reliable service. Forgings and powdered metal are used in many cases. Every Lodding fixture is Parkerized to prevent rust.

AND YOU GET IT QUICKLY

Immediate shipment from completely stocked, coast-to-coast distributors. You receive parts much faster than you can make them yourself.

Lodding INC.

81 BEACON ST., WORCESTER 1, MASS.

THE LINE
OF JIG AND FIXTURE COMPONENTS

Write for Catalog *— includes full-scale layouts of every Lodding fixture. No obligation.*

CIRCLE INFORM-A-GRAM KEY NO. 21

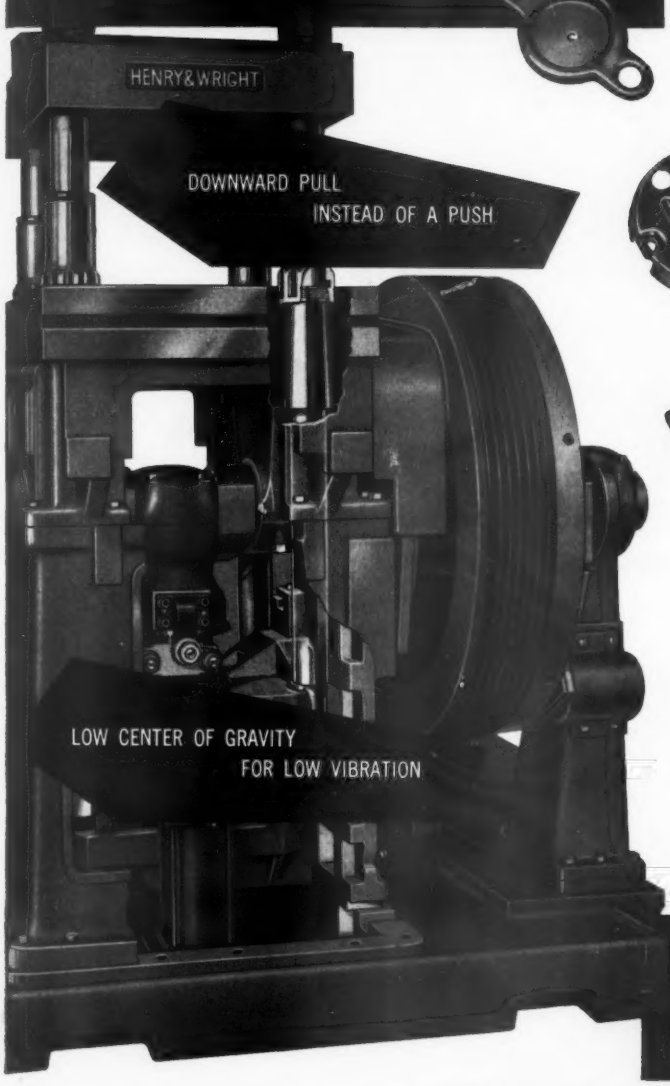
YOU CAN LINE UP JOB AFTER JOB

The Henry & Wright Dieing Machine is easy enough to set up so that moderate production runs are profitable.

You can schedule one job after another. Your H & W will get the work out, get it out right, and have it done when the schedule says it ought to be done.

Simple jobs that you want to complete at high speed. Close tolerance work. Tricky reverse bends. Full assemblies at one pass through the press. They all will go through your Henry & Wright, and with surprisingly short interruptions for setting up.

Four corner control of side thrust, and a downward pull instead of a push: These are two of the reasons why your Henry & Wright will withstand more off-centering of the die loads. Jobs like those shown can be easily run in sequence on an H & W.



Henry & Wrights are making production runs that designers never had dreamed could be stamped at a profit. Our representative would like to show you some of the pieces.

Please write to Henry & Wright, 511 Windsor Street, Hartford, Connecticut.

H&W®

HENRY & WRIGHT

DIVISION OF EMHART MFG. CO.

HARTFORD, CONNECTICUT

CIRCLE INFORM-A-GRAM KEY NO. 22

..checked for accuracy by ATOMIC LIGHT..

JOHANSSON GAGING EQUIPMENT

Swedish Johansson Gage Blocks are checked for accuracy by the latest scientific method, the atomic light, utilizing the lightwaves emitted from the Mercury isotope 198, now in use at the standard Bureaus throughout the world.

Assures You Precision to the Finest Degree to Meet Your Requirements —Backed by the Name Supreme in the World of Measurement.

GAGE BLOCKS

(JOHANSSON) and accessories.
Short deliveries. Inspection and reconditioning service available at our plant.

INTERNAL INDICATORS

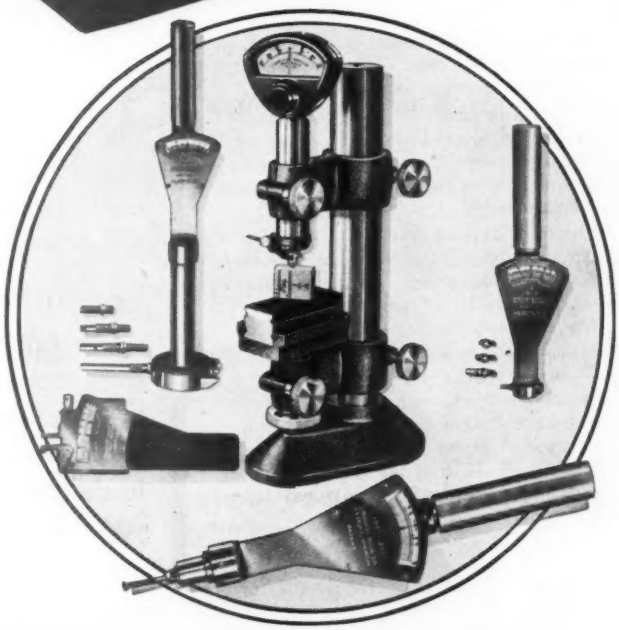
(for inside measurements .155 to 24 inches) Scale range plus or minus .001 graduated to .0001 and minus .020 graduated to .0001.

MIKROKATOR

(Amplifier—for outside measurements) Graduations .0001 to .000002 or .001 M to .0002 M.

OTHER JOHANSSON PRODUCTS

Micrometers, Snap Gages, Extensometers, Dynamometers, Hardness Testers, Surface Finish Indicators, Interferometers, Plugs, Rings and Special Gages.



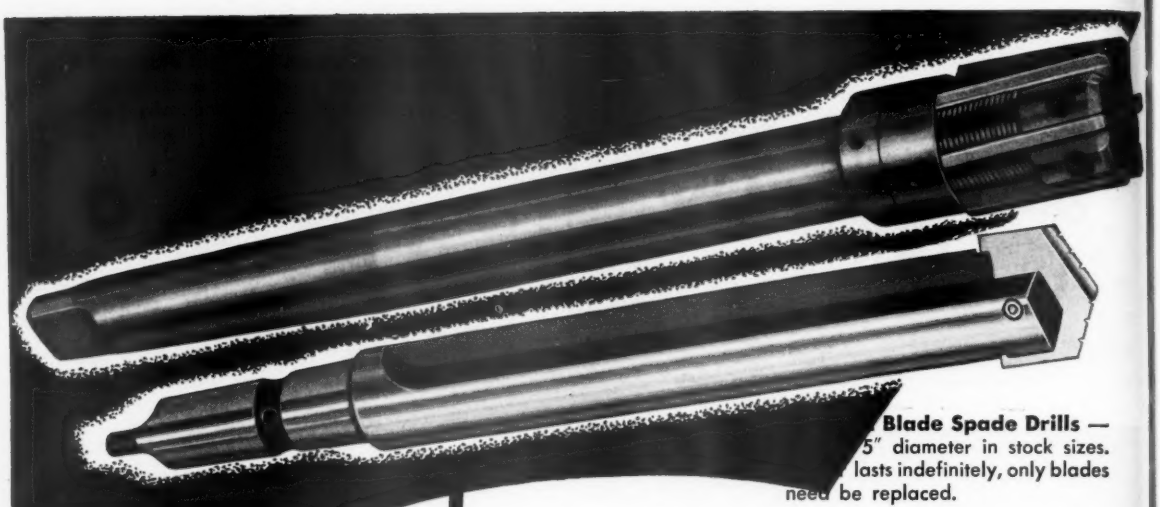
Write for Literature

C. E. JOHANSSON GAGE CO.

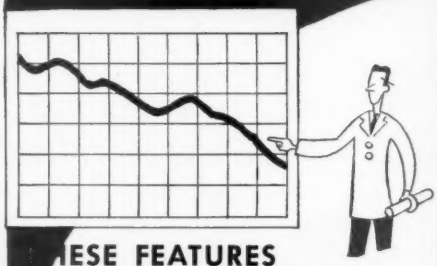
A DIVISION OF SWEDISH GAGE CO.

10641 HAGGERTY AVE. • BOX 4086 NORTHEASTERN STATION • DEARBORN 1, MICH.

CIRCLE INFORM-A-GRAM KEY NO. 23



Blade Spade Drills —
5" diameter in stock sizes.
lasts indefinitely, only blades
need be replaced.



Cut Tooling Costs

with WAUKESHA Standard Cutting Tools...

Adjustable Blade Reamers — Inserted Blade Spade Drills — and other Standard Cutting Tools by Waukesha — are saving thousands of dollars in tooling costs, in all types of reaming, drilling and boring operations. Their versatility and adaptability eliminate substantial investments in special tools — and their inherent features result in operating and maintenance economies which you cannot afford to overlook.

consult WAUKESHA

— for Competent Cutting Tool Counsel. Waukesha sales representatives and engineers are qualified to work with your staff in adapting Standard Waukesha Tools to your needs — or, if necessary, in developing Special Cutting Tools for your unusual needs.

Representatives in Principal Cities

IESE FEATURES f Standard WAUKESHA Inserted-Blade Cutting Tools Save You Money —

Replaceable Blades — Cost only a fraction of the price of a solid tool, assure long term economy.

Interchangeability — Each size of Waukesha Spade Drill Holder takes a ½" range of sizes in spade blades, except in the smaller sizes which cover only a ¼" size range.

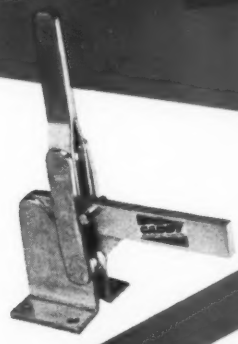
Shear-Cutting Action — Waukesha Blades have a "knife-slice" cutting action that curls chips away from stock, prevents scoring, assures free cutting, requires less power.

More Grinds per Blade — More Holes per Grind
Waukesha Blades can be advanced and re-ground before discarding — yielding a substantial saving over High Speed Solid Steel Tools — and the high quality of Waukesha Blade Stock assures More Holes per Grind.

Your Catalog for...

CADDY TOGGLE CLAMPS

BETTER CLAMPING



EXTRA LARGE PIVOT PINS
Up to 3 times more bearing surface than other clamps.

ALL WELDED CONSTRUCTION
Will not come apart even after pins become excessively worn.

HEAVIER FRAME
Will not spring or bend under maximum load.

HEAVIER LINKS AND HANDLE
Will withstand extreme abuse. Pipe extension handle may be used without damage to linkage.

CO PRODUCTS, INC.
70 EAST 61ST PLACE • CLEVELAND 3, OHIO

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☐ Send Descriptive Literature
☐ Have Representative Call

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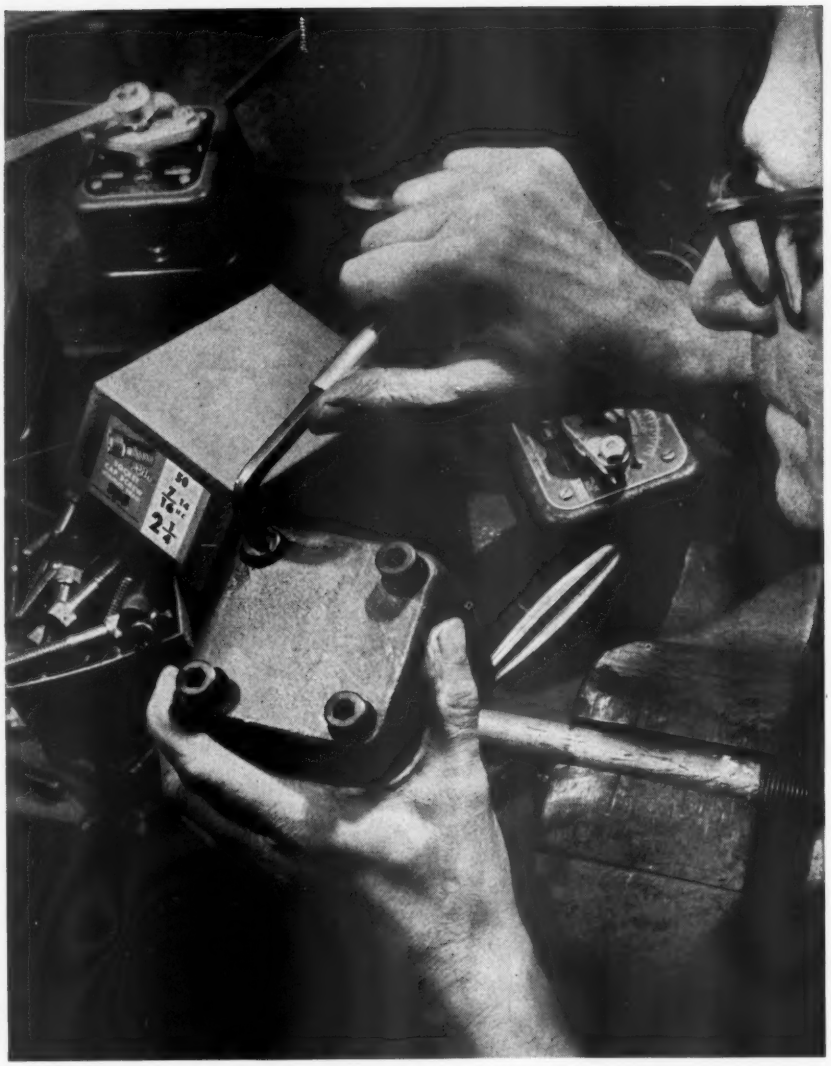
COMPANY _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

CIRCLE INFORM-A-GRAM KEY NO. 25



Four UNBRAKO Socket Head Cap Screws speed assembly in the plant, and reassembly in the field, of these flow-control valves providing 16 different inlet-outlet flow direction combinations.

The knurling on the head of the screw permits faster assembly, because it provides a slip-proof grip.

The uniform depth and size of the hex socket assure maximum torque in wrenching. The accurate diameter of the head permits countersinking.

UNBRAKOs—made of heat treated alloy steel—have fully formed threads, Class 3 fit; controlled fillet and continuous grain flow for strength. Supplied in standard sizes from #4 to 1".

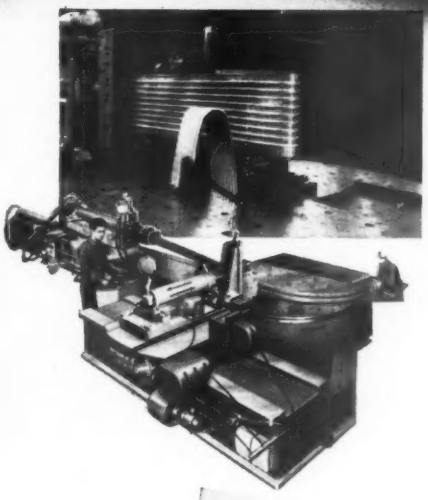
Get personalized service, faster delivery with UNBRAKO Standards—stocked by your distributor

When you use UNBRAKO socket screw products, you get the finest socket screws made, *plus* the personalized service and the faster delivery of your local distributor. And he enables you to cut your inventory, set up more space for production. For more information, write for UNBRAKO Standards—a complete listing of precision socket screw products carried by your distributor. STANDARD PRESSED STEEL Co., Jenkintown 36, Pa.

UNBRAKO® SOCKET SCREW DIVISION SPS JENKINTOWN PENNSYLVANIA

CIRCLE INFORM-A-GRAM KEY NO. 26

HEAT DEFLECTION...
...at 2000 M.P.H.



The newest approach to the problem of the phenomenal heat generated at high speeds, known today as the THERMAL BARRIER, is to deflect the heat from the pilot and vital parts of the plane.

Photograph to the left shows the deflecting, or corrugated sheets being formed on a BATH Stretch Forming machine. These particular corrugated sheets are for leading wing-edge construction.

Catalogs describing BATH Stretch Forming, Compression Forming, Radial Draw Forming, or Contract Forming are available for the asking...

THE CYRIL BATH COMPANY

32380 AURORA ROAD • SOLON, OHIO
(LOCATED IN THE GREATER CLEVELAND AREA)

MANUFACTURERS OF RADIAL DRAW FORMERS • DIES • TOOLS • PRESS BRAKES • TANGENT BENDING SEQUENCE PRESSES • PRESS TYPE BRAKES • SPECIAL MACHINES

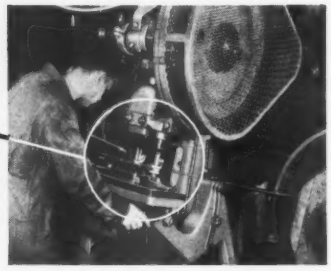
CIRCLE INFORM-A-GRAM KEY NO. 27

money saving

Accessories for your plant

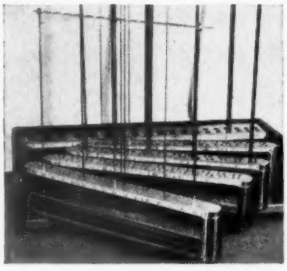
Each of the accessories illustrated and described below was designed and built for a definite need and used in our own plant before being offered to industry. They require a relatively small investment, yet will save you money every day. For further information, write for the folder offered below.

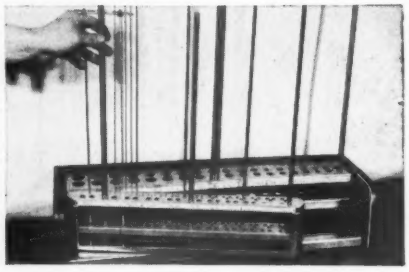
LEADER PIN OILERS



Eliminate wear on your die sets with these leader pin oilers. Acro Pin Oilers, as illustrated, fit over each leader pin and seals in place with a rubber neoprene washer. Each cup is filled with oil so each downward stroke brings bushing in contact with oil and each upward stroke distributes oil evenly over leader pins. Eliminate bushing wear, leader pin scoring, and maintain die accuracy. Die sets equipped with Acro Pin Oilers have run under tests for several weeks to a month without refilling.

DRILL ROD RACKS



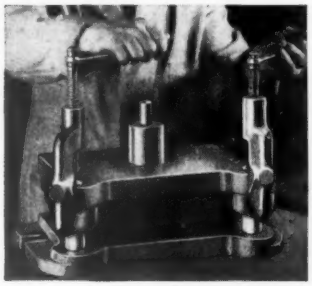


Eliminate trouble and waste effort with this modern method of storing drill rod. Put the Acro rack in a central location of each department and make it simple for each mechanic to select correct rod size in a hurry. It also provides a visual inventory for checking rod replacements.

Accommodates 26 letter sizes, 52 pieces; 47 fractional sizes, 138 pieces; 60 number sizes, 304 pieces. Fractional sizes graduated in 64ths from 1/32" to 1/2" and in 32nds from 1/2" to 1" included.

Also available in half size with fractions or numbers.

DIE SET PULLERS



The principle of the Acro Die Set Puller is to remove the punch holder from the die shoe by a straight upward pull, whereby punch holder travels upward from die shoe axially, leaving both leader pins simultaneously. This is accomplished only by use of the indexed screw wrenches which act as indicators, controlling the upward travel. This is an exclusive patented Acro feature, found only in Acro Die Set Pullers. Available in three sizes.

Free Data

covering each of these profitable accessories is included in our folder. Write for bulletin TP-54.

ACRO

METAL STAMPING CO.

330 EAST RESERVOIR AVE.

MILWAUKEE 12, WIS.

CIRCLE INFORM-A-GRAM KEY NO. 28

Announcing

a completely AUTOMATIC, self-contained, PORTABLE drilling unit with advantages you expect only in expensive machine tools

Peck drilling four deep holes in a magnesium casting

THE NEW SERIES 92A KELLER "AIRFEEDRILL"

—locks to any jig or fixture, and drills accurately. Stationary mounting brackets available

—operates automatically through the complete drilling cycle—advances, drills, retracts, shuts off—at a single pressure of the control valve

—handles peck drilling and skip drilling

—gives complete control over motor speed, drilling speed, torque, rate of advance, and depth of hole

It has these operating features:

SENSING TYPE RAPID ADVANCE brings the drill point quickly to the work, then drops instantly to the drilling rate.

TORQUE CONTROL causes automatic retraction as often as necessary to clear chips during peck drilling. It also protects drills and indicates when they need sharpening.

FEED CONTROL permits adjustment to varying drilling conditions, as well as the material being drilled.

VARIABLE SPEED MOTOR controlled by throttle valve . . . shuts off automatically at end of drilling cycle.

Lightweight and compact—ideal for use in portable or stationary applications

These and other features mean that you can tool up for a few hundred dollars . . . instead of thousands. Send for Catalog Section 92 which fully describes and illustrates this remarkable new tool.

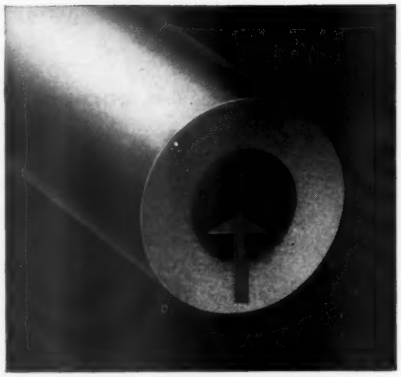
KELLER "Airfeedrill"

SERIES 92A

KELLER TOOL COMPANY, 1313 Fulton St., Grand Haven, Mich.

CIRCLE INFORM-A-GRAM KEY NO. 29

a hole here makes waste...



a hole here makes a saving

Crucible Hollow Tool Steel Bars **are a boon to the metalworking industry. The hole in these quality bars enable toolmakers to eliminate drilling, boring, cutting-off and rough-facing operations. This cuts production time, boosts machine capacity and saves scrap losses.**

They are available now, in any of Crucible's famous tool steel grades, in almost any combination of O.D. and I.D. sizes. And you can get *immediate* delivery of five popular grades — KETOS oil-hardening, SANDERSON water-hardening, AIRDI 150 high carbon-high chromium, AIRKOOL air-hardening, and NU DIE V hot-work tool steels — from a conveniently located Crucible branch warehouse.

Let your Crucible representative show you how these steels can best help *you*.

CRUCIBLE first name in special purpose steels

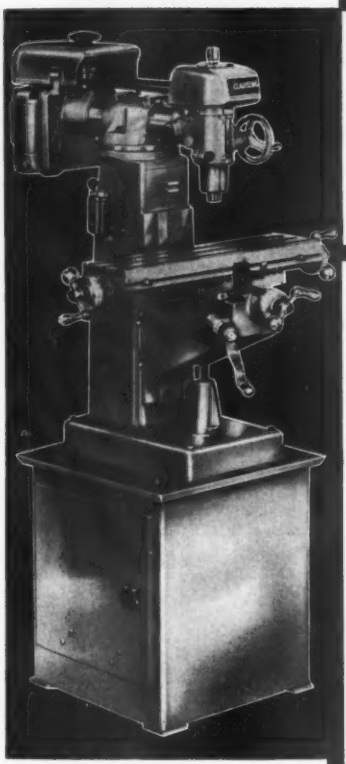
54 years of Fine steelmaking **HOLLOW TOOL STEEL**

CRUCIBLE STEEL COMPANY OF AMERICA · TOOL STEEL SALES · SYRACUSE, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 30

You can cut PRODUCTION COSTS with the—

CLAUSING PLUS VALUE LINE!



The Great New CLAUSING PLUS VALUE Lathes, Drill Presses and Vertical Millers offer you one sure way to meet today's competition through lower production costs! Feature by feature . . . dollar for dollar . . . or by any other basis of comparison these new machine tools are the leaders in their fields for Accuracy . . . Capacity . . . Versatility . . . and Economy! For heavy duty production, tool room, maintenance, experimental or research work, they are also designed to give you the maximum performance per dollar invested in original equipment and operating costs. Investigate before you buy! Write today for fully illustrated literature.

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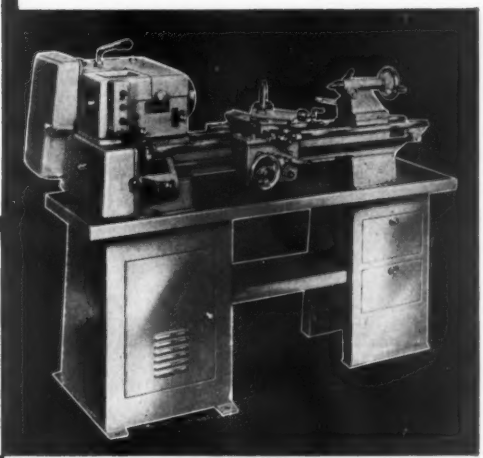

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CARBIDE INSERTED DRILL JIG BUSHINGS

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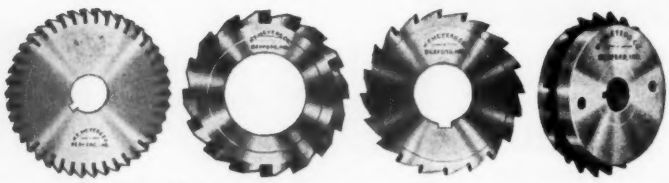

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NOTE: Additional sizes are being added daily, considerably augmenting the above list. Stock Hydraulic Cylinders also available.

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Eliminate Breakage

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WHAT'S THIS?

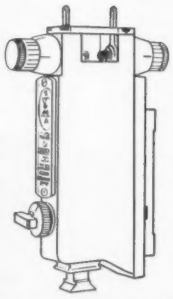
HIGH SPEED 100% INSPECTION

SIGMA

One machine is accurately checking 8 dimensions simultaneously—separating correct, oversize, and undersize parts at a rate of 2100 an hour.

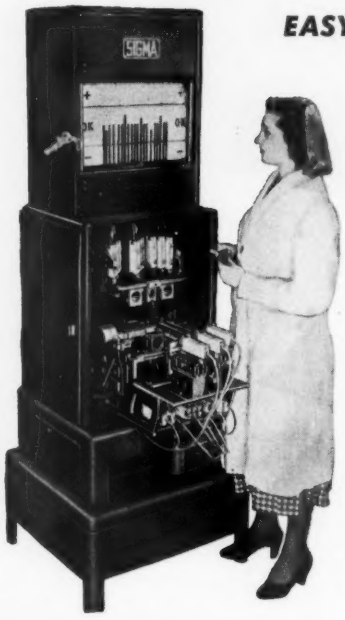
Two girls now handle an inspection job that formerly took six—and human errors have been eliminated.

Eight, standard Sigma gauges, like this one: have been mounted together for rapid, accurate inspection of mass produced parts. Each gauge, accurate to within .00005", measures one dimension. More (up to 30) or fewer gauges could have been used, depending on the number of dimensions to be checked. These gauges, with standard Sigma mounting units, and special fixtures where necessary, can be set up to inspect parts a fraction of an inch long, or several inches long, a foot, or longer.

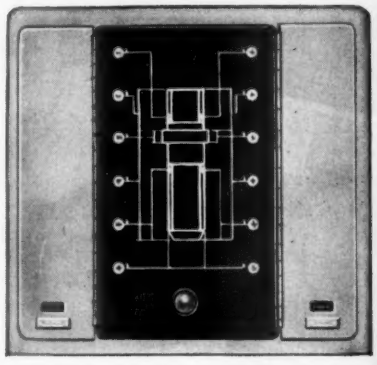


Depending on the arrangement, they can check internal and external diameters, length, depth, or other characteristics. The type of parts and the method of feeding determine inspection rates—hand feed: up to 600/hr.; semi-automatic: up to 900/hr.; fully automatic: up to 3500/hr. or more. Gauges are quickly and easily set to required tolerances and change-over from inspecting one type of part to another can be done within 10 or 20 minutes.

EASY-TO-READ INDICATORS WITH SIGMA EQUIPMENT



The semi-automatic Turbine and Compressor Blade Inspector (left) is an excellent example of Sigma's solution for a difficult inspection problem involving 18 dimensions. Fixtures are replaceable—each machine can inspect a wide range of different type parts. Gauges are connected to a Liquicolumn Indicator which has tubes of colored liquid set beside graduated scales—liquid levels indicate actual sizes of dimensions being checked. Magnifications can be varied easily by the user. Alternate indicator (right) uses electrical signals—green light for acceptable parts, red lights indicate dimensions below tolerances, yellow lights for those over. Built-in counters tabulate the number of parts submitted for inspection and the number accepted.



Get more information about Sigma multi-dimensional inspection equipment at the ASQC Convention. We'll be in booth 29, Philadelphia Convention Hall, on May 27, 28 and 29.

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Sold only through leading Industrial Distributors.

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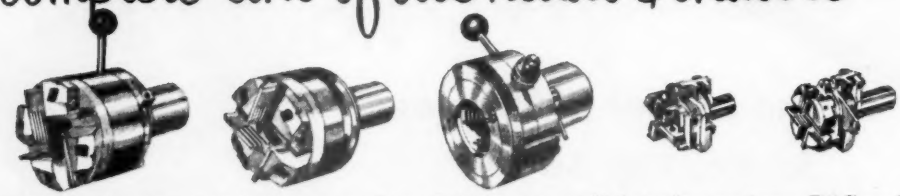
a complete line of die heads & chasers



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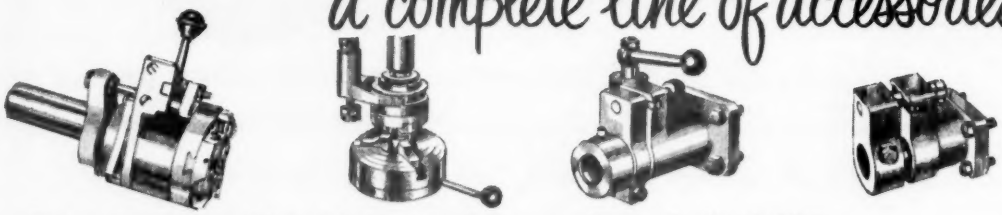
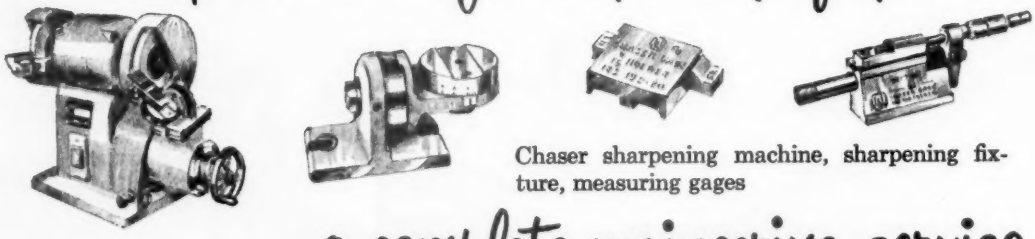


External and internal trip attachments, drill press adapter, floating holders

a complete line of sharpening equipment



Chaser sharpening machine, sharpening fixture, measuring gages

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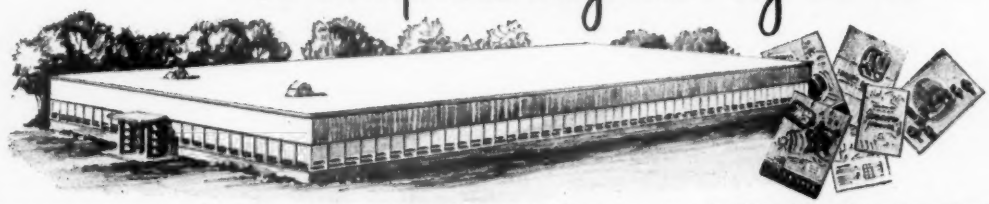

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P.S.

J&L Automatic Opening Die Heads and Chasers assure: low initial cost — ease of operation — controlled resharpening — use of carbide where applicable. Class III threads guaranteed. This means important savings regardless of your tolerance requirements. Write to Dept. 710 for complete information.

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easy as **A**—locate diameter wanted
B—choose type reamer
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SHANK	Straight	Straight	Taper			Straight	Taper	Straight	Straight	Straight
FLUTE	Straight	LH Spiral	Straight	Straight	RH Spiral	Straight	Straight	Straight	Straight	Straight
LENGTH	Regular	Regular	Regular			Regular	Regular	Regular	Production	Regular
LIST NO.	500	503	506	521	524	531	532	533	533-0	533-3
DIAMETER	NET PRICE EACH									
.4218	27/64"								2.58	2.46
.4355						5.01	5.84	2.58		2.46
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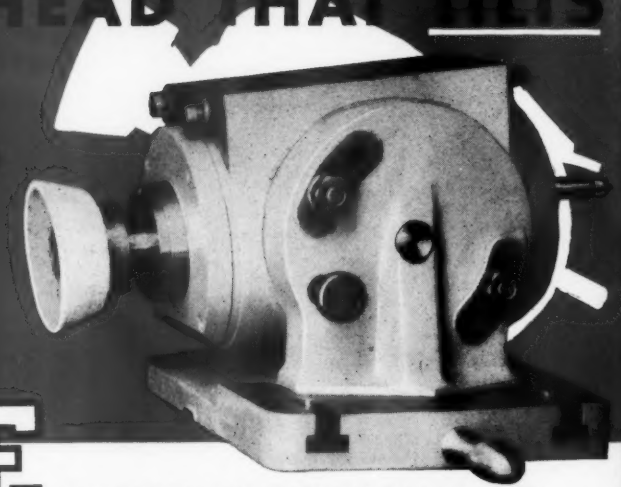
and Yours Will Nod, Too When You See What You Can Do With This One



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With Angular Adjustment In A Vertical Plane

Give this versatile head the nod and save time and money these seven ways:

1. You can use cup wheels for practically all clearance angles and thus produce a cutting edge on tools that lasts longer because it is stronger.
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3. You can grind most cutters and reamers all over *with a single set-up* using the swivelling table and Pope tilting head.
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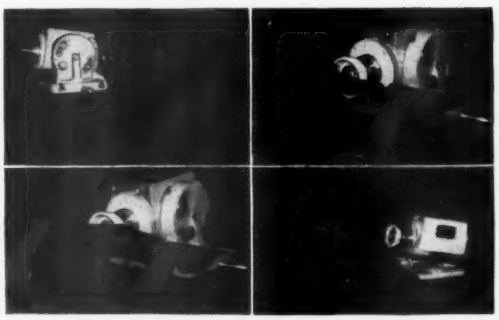
7. You have a head that's so easy to adjust and use it saves you time and money every time you grind a tool.



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No. 101

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Save every way! No costly holding fixtures needed for most work. No time-wasting set-up. Easy operation quickly provides vivid screen image, reveals costly production errors. Micrometer stage (optional) reads to .0001".

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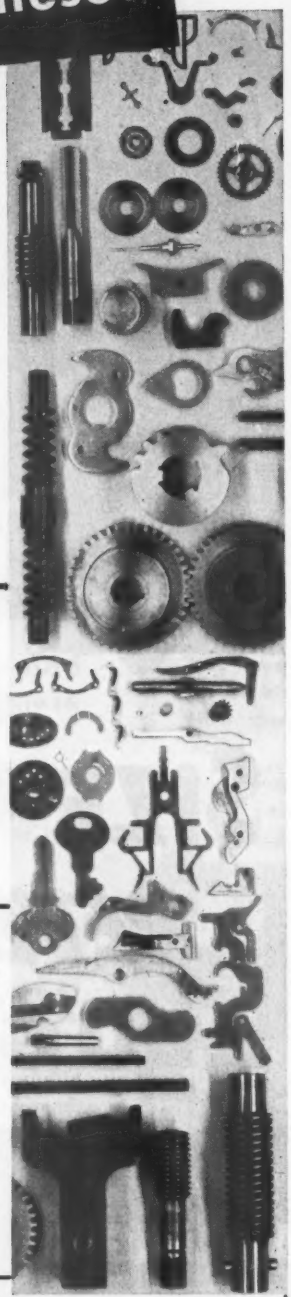
3 **Bausch & Lomb TOOLMAKERS' MICROSCOPE**
Quickly measures or inspects opaque or transparent objects of any contour. Linear readings to .0001"; angular, to 1 minute of arc.



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Quality Control
INSTRUMENTS

CIRCLE INFORM-A-GRAM KEY NO. 42

★ ★ ★ ★ ★ ★ ★ ★

Talk of the Month

★ ★ ★ ★ ★ ★ ★ ★

PROGRESSIVE TRANSFER OF SKILLS FROM OPERATOR TO MACHINE*

WEBSTER'S DICTIONARY says, "Engineering is the art and science by which properties of matter and the sources of power in Nature are made useful to man in structures, machines and manufactured products." This definition recognizes the essential of the human, particularly in the area of being the one who practices the art and who benefits from the useful result.

Indications are that the useful result is made further possible by a third element relating to the

by W. G. Johnson
Manager Research and Engineering
NORTON COMPANY
Worcester 6, Mass.

human being, and that is to have the design or engineering embody some of the outstanding attributes of the marvelous elements of matter, motion, and instruction with which the human body is graced.

Not too many years ago the principle of grinding was considered an art. The grinding machine provides the necessary basic motions and control, but the skill of the operator plays a prominent part in the use of these controls to get the result from the machine. The human skill supplements the machine by providing the senses of touch, feeling, hearing, and seeing, tele-

. . . *Continued on page 92*

*Presented by the author at a joint session of the Machine Design and Production Engineering Divisions of The American Society of Mechanical Engineers, at its 1954 Fall Meeting and reprinted here in abbreviated form by permission of the Society.

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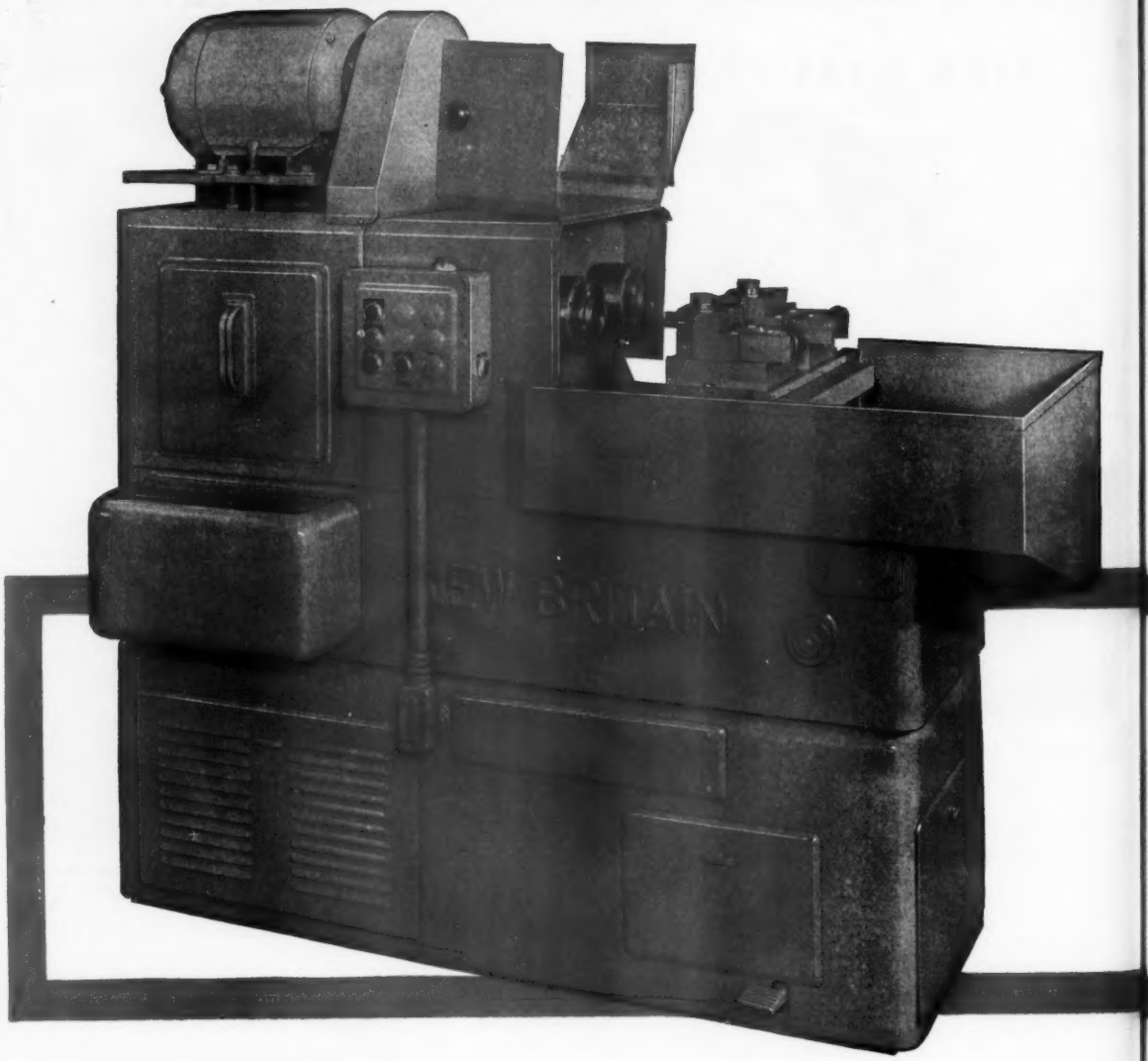

New Britain's exclusive application of cam control (illustrated diagrammatically on the opposite page) gives your tool engineer a completely new approach to tooling for complex pieces. Methods impossible on other types of machines can be employed to speed production and eliminate second operations.

A New Britain precision boring machine will not only turn out a wide variety of work at high speeds, but, because of New Britain's exclusive method of cam actuation, will continue producing them with the same repetitive accuracy — piece after piece, week after week.

Write for descriptive literature on the New Britain boring machine line, including the details of a variety of specific parts turned out on New Britains.

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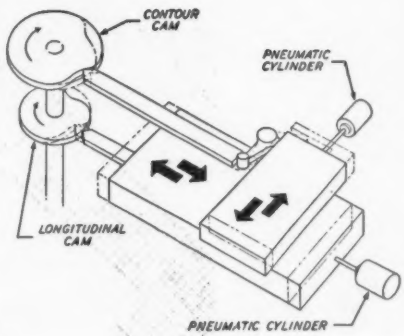
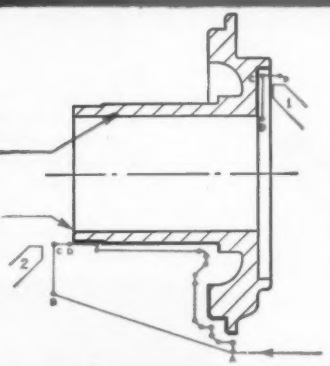
- Cam shaft, as well as super precision spindles and their motor drive solidly and permanently mounted to frame for continuing accuracy.
- Rugged precision lever transmits cam motion to cross slide.
- This exclusive method means simple permanently accurate compound slide motion for an endless variety of single point tool paths.



Expanding arbor chucks piece on I. D.

Back face positively locates against chuck.



With conventional methods, pieces like this present a problem of costly tooling. With New Britain's new approach, tooling this piece is fast, simple and economical with a single chucking and two single point tools.

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THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division, New Britain, Connecticut

Our general catalog is filed in the Sweet's Machine Tool Catalog File.

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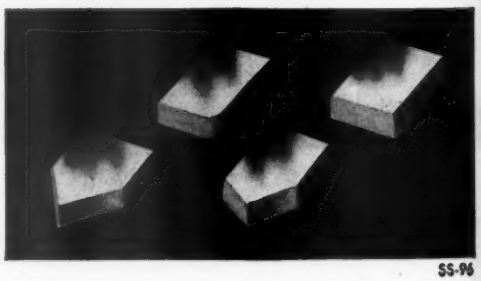

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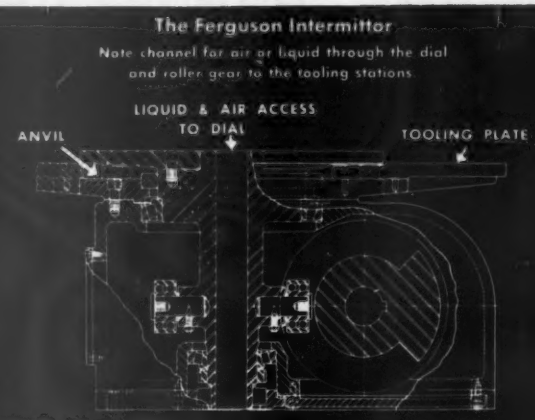
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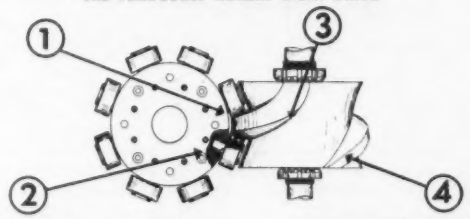

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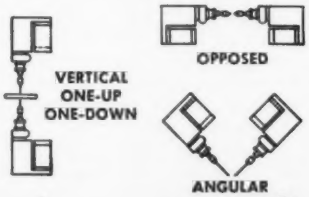

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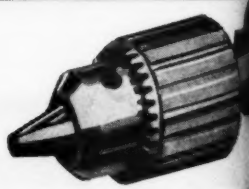

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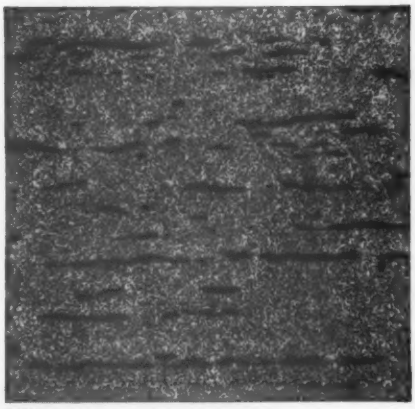
Wearability—*Outwears other tool steels 3 to 1*

Stability—*Is the most stable gage steel ever made*

Machinability—*Cuts machining time 30%*

YOU can make gages and dies that stay accurate longer and produce them in less time by using Graph-Mo® graphitic tool steel. That's because only Graph-Mo gives you the combination of wearability, stability and machinability that you want in a tool steel.

Free graphite and diamond-hard carbides in the structure of Graph-Mo steel give gages and dies extraordinary life. Reports from users show that Graph-Mo outwears other tool steels 3 to 1.



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In your plant, Graph-Mo steel will cut production time and rejects. Because of its graphitic structure, Graph-Mo steel machines 30% faster than other tool steels. This structure also gives excellent resistance to abrasion, and has minimum tendency to pick up, scuff or gall. Tests on Amsler Wear Machine show Graph-Mo has twice the resistance to galling when compared with ordinary tool steels.

The greater stability of Graph-Mo steel enables you to make gages that stay accurate longer. After 12 years of service, for example, a typical Graph-Mo steel master plug gage showed less than 10 millionths of an inch change from its original dimensions.

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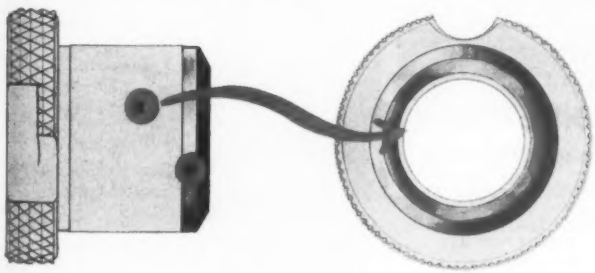

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PROGRESS ON PARADE 156
Check this carefully. It can bring new efficiency to your operation. This newest in machines, tools, and accessories.

Want PRECISION SHEARING at *HIGH SPEED?*

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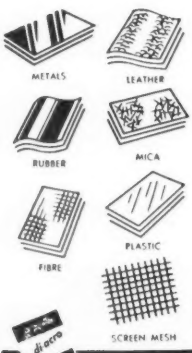

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CIRCLE INFORM-A-GRAM KEY NO. 54

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SURFACE PLATES. "It Takes a 3-Point Specification to Insure Surface Plate Flatness", by R. J. Rahn, Rahn Granite Surface Plate Co. 123
Since the surface plate is the foundation of interchangeable parts manufacturing, the accuracy of flatness that can be expected in a surface plate is of primary importance to the user.

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"AIR CYLINDERS IN AUTOMATIC DIES"

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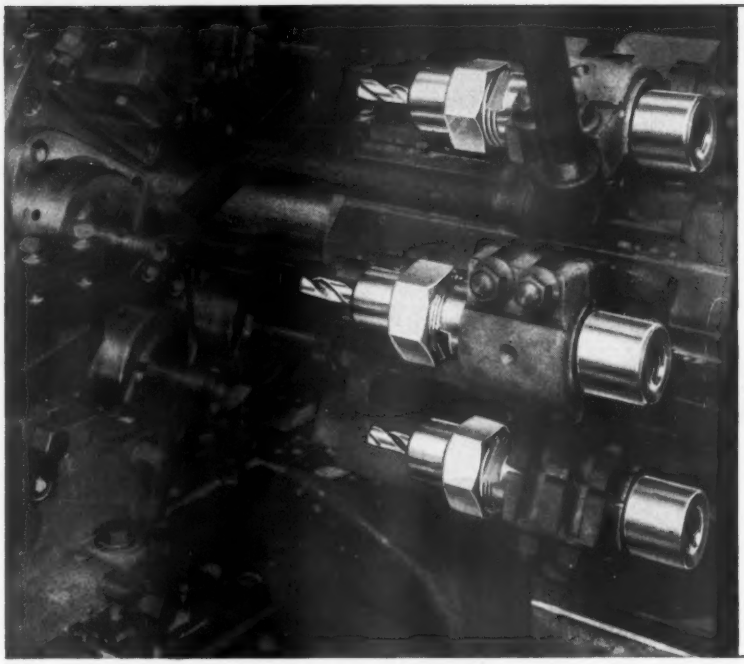

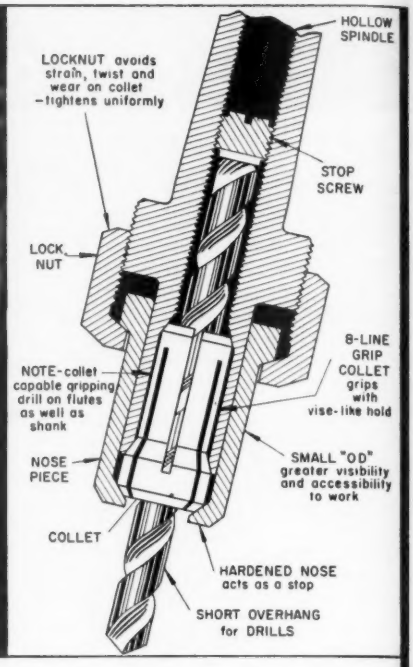
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LOCKNUT avoids strain, twist and wear on collet —tightens uniformly
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LOCK NUT
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NOTE-collet capable gripping drill on flutes as well as shank
SMALL "OD" greater visibility and accessibility to work
NOSE PIECE
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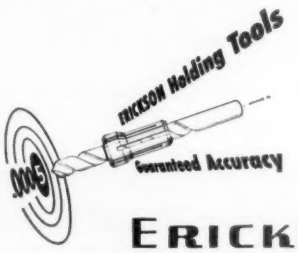

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editorial

stand-by plants? why not stand-by training?

We have just learned, from Chrysler Corporation, that the Chrysler-managed Michoud Ordnance Plant in New Orleans — the Army's huge 43-acre tank engine production center in the South — has become the largest and most outstanding "stand-by" defense manufacturing installation in the United States.

R. E. Hewlett, general manager of the Chrysler Tank Engine Division, advises that the plant, maintained on a stand-by basis for the Army with a permanent force of 115 workers, can be reactivated almost overnight for the mass production of engines for medium and heavy tanks.

This is, indeed, in wonderful contrast to the heretofore Government practice of "moth-balling" defense plant equipment. Moth-balling, a non-productive procedure of morgue-like aspect, would have involved coating all machines with heavy grease, dusting them with corrosion-inhibiting crystals and encasing them in a cocoon of wire mesh, anti-corrosion paper and a gelatin substance to seal them from the air. The machines would then be put in storage — dead storage.

Consequently, three to four months would be required to begin putting moth-balled equipment into operation. "By comparison", Hewlett said, "we can begin machining parts within a matter of days and could be in tank engine production in a matter of weeks, provided ample manpower and materials were available."

The end result in this particular case, and there are, and will be, others elsewhere in the country, is a modern, 2,000,000-square foot, production plant with some 2400 machine tools kept in excellent operating condition — all set to go. Each machine is cleaned and oiled regularly and any defective parts are repaired or replaced.

Many of the more intricate machines, such as gear grinders, involve electrical circuitry and controls that would deteriorate unless used. Accordingly, the machines are "cycled" or run periodically to check their performance. After cycling, the machines are inspected for rust and wear. Conveyors, hoists, hydraulic lifts and electric motors are also cycled regularly.

So we have, on a small operating scale but actually in a mass production plant, all of the essential ingredients of a going concern.

What better setup could there be, both for peacetime industry as well as for preparedness, in the way of a training facility of unprecedented magnitude? Twenty-four hundred of the machine tools and complementary tooling necessary to mass-produce internal combustion engines!

Industry should be able to arrange with Army Ordnance to send trainee maintenance men in to such a plant to learn, by performing the periodic inspection, repair, replacement, and "cycling" jobs, more in two weeks about more machines than they possibly could within their own plants.

Men who have been pegged by their managements for future tooling and production supervisory jobs could be given an intensive indoctrination in a far greater variety of high production machines and tooling than they could get in any other way. Army Ordnance should welcome such a learn-by-doing program because if the time should come when such a plant were activated for defense there would be at least a nucleus of members of the tooling and production team well versed in military specifications, manufacturing limits, assembly problems, and final tests. To let a group of men, destined for key positions in industry, actually build a few engines, mortars, or shells, would be invaluable insurance against the time when these men might have to supervise others in producing for defense — or survival.

After a pilot run, then the maintenance trainees could come in and do the necessary.

Many of us have vivid recollections of the critical training days of 1939 to 1943 before we really hit our stride in war production.

Last, but far from least, think of the value to college engineering students of spending the summer following their junior year in a stand-by plant. The concept they would get of the oneness of tooling and production, the impact upon them of seeing, hearing, and sensing through learning-by-doing that without tooling there could be no production and that tooling, in itself, is but a museum piece unless put to work in production — all of this would be a practical phase of formal engineering education which would make the boys of unmeasureably greater value to their post-school employers.

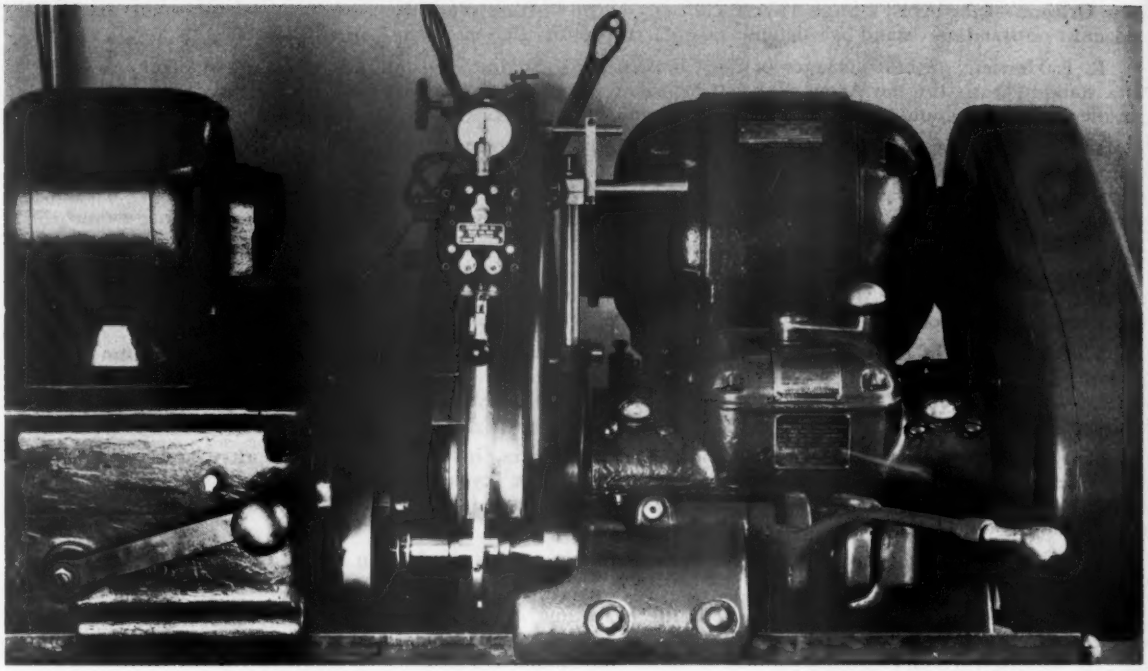
There are those who will say that such proposals as put forth here would only cause consternation, confusion and chaos in a stand-by plant. But don't forget why a stand-by plant is standing-by. Surely we could better afford a little consternation, confusion, and chaos now than after the sirens start blowing.

What do you think?

E. Willard Pennington

editor

FOSTER SIZE CONTROL FOR OVER 50 YEARS



FOSTER ELECTROSIZER SIZE CONTROL GAGES

The benefits of the "Electrosizer" has been well established as a means of controlling the size of the work, the proper feeding of the grinding wheel to the work piece and the elimination of the human element in the control of the sized piece.

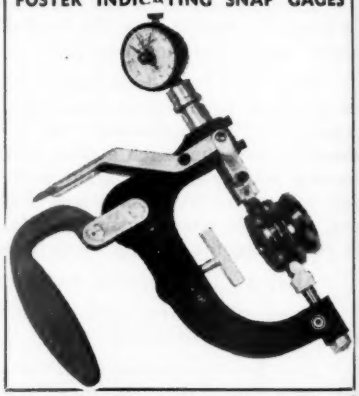
It is an established fact that the proper feeding of the wheel can eliminate 50% of the wheel dressing due to a constant feed, which is the ideal condition for grinding on precision work. The grinding wheel breakdown with uniform grinding feed is controlled by the Foster "Electrosizer" Gage and in one installation has proved that the saving in grinding wheels alone has paid for the equipment in one year.

The gages are made in one, two and three station "electrosizer" contacts, which operating through the controls in the machine, automatically performs all the functions of the hand operations by the machine operator and does it in a much more satisfactory manner.

Our engineers are at your service to survey your problems and give you every assistance possible in this new development of grinding.

Why not contact us for assistance on your grinding problems?

FOSTER INDICATING SNAP GAGES



Example of special application. Pitch diameter and O.D. on Splines, Gears, depth of Keyways, etc.

Foster Indicating Snap Gages are sturdily built for long life and maximum efficiency. Built-in compensation for wear insures accuracy of these Gages even after long periods of usage. Regularly furnished without extension handle if desired.

Available in all sizes.

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CIRCLE INFORM-A-GRAM KEY NO. 58

OCTOBER, 1954

7th Annual

QUALITY CONTROL

Feature Issue

TOOLING & PRODUCTION
The Magazine of Manufacturing Management

1934 - 1954 20th ANNIVERSARY YEAR

STATISTICAL QUALITY CONTROL IN PRECISION MANUFACTURE

by Alvah Allen, Manager, Quality Control

MINIATURE PRECISION BEARINGS, INC., Keene, New Hampshire

STATISTICAL QUALITY CONTROL is frequently considered practical only for quantity production in a large plant where unit cost is low and precision requirements are not severe. Our company's experience in the production of small, high precision ball bearings shows, on the contrary, that statistical control methods properly applied can be a powerful manufacturing tool whatever the size of the product, company, production quantities or tolerance ranges. As with any precision product which must always equal or exceed rigid industry standards, the introduction of statistical quality control at Miniature Precision Bearings, Inc. has not only served to increase the quality of the shipped product but has immeasurably improved employee and customer relations as well as producing considerably lower manufacturing and inspection costs.

The Product

Our company manufactures about 400 different types of miniature ball bearings as standard products — radial (Fig. 1), super-light radial, radial retainer, spring separator, flanged radial, flanged radial retainer, separable, angular contact, pivot and thrust bearings, each in a number of different diameters. Our largest bearing is ⅜" in outside diameter and the smallest at present (the radial bearing in Fig. 2) is 1/10" in outside diameter, with inner race, outer race and seven .65 mm balls.

MPB ball bearings conform to the high-precision requirement of Classes 5 or 7 set forth by the Annular Bearing Engineers Committee. In addition, many bearing users require even closer tolerances for special applications. Most dimensions must be maintained to within 0.0002" and on occasion to within 0.00005".

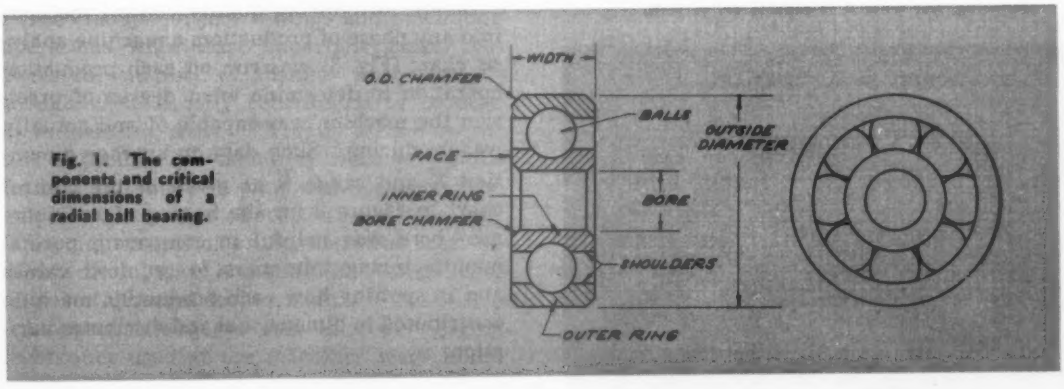


Fig. 1. The components and critical dimensions of a radial ball bearing.

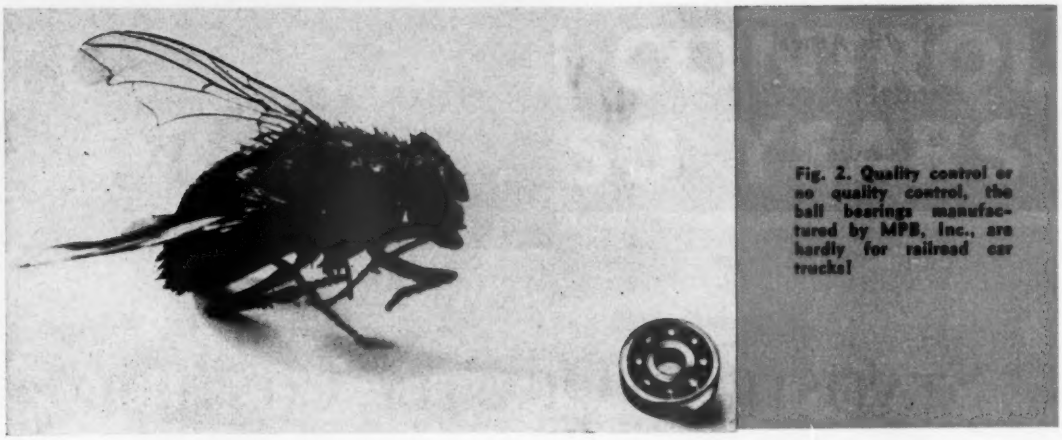


Fig. 2. Quality control or no quality control, the ball bearings manufactured by MPB, Inc., are hardly for railroad car trucks!

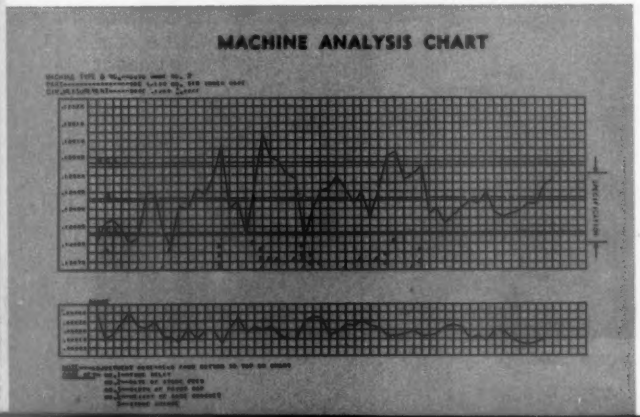
Miniature ball bearings are used in many types of precision instruments where only lightweight, low friction, minimum space and small radial motion are tolerated. Typical instruments and precision mechanisms in which miniature bearings are used include gyroscopes, recording and measuring devices, accelerometers, synchros, servo motors, and potentiometers.

The Company

Miniature Precision Bearings, Inc. is a company of approximately 200 people, virtually all highly skilled machinists or inspectors with long experience in the manufacture and assembly of very small components. Standard machine tools are used in manufacturing miniature bearings wherever possible, although the size and accuracy of the bearings frequently require the development of special machinery in the plant or special tooling adaptations of standard equipment. Thus, a well equipped tool room and a skilled tool engineering staff have been developed to perform these very important functions.

The balls are purchased from outside sources so that the basic production operations are machining of the inner and outer races from raw bar stock, assembly of the races and balls, and inspection.

Fig. 3. The machine analysis chart discloses not only the degree of precision to which a machine is producing, but what it is capable of, as well.



First Step: To Determine Initial Conditions

The first step in introducing statistical quality control at Miniature Precision Bearings, Inc. was to determine the quality picture which had existed without statistical control. Briefly, there was little formal control of production operations (other than by the machine operator himself) in any phase of manufacture, while 100% inspection had been standard practice for many years.

Although 100% inspection assured a precision product for the bearing user, inspection costs were extremely high. These costs included an unnecessarily large number of inspectors, a comparatively high reject rate and excessive reworking. Normal manufacturing variations on the special production machinery were not always known.

Most manufacturing employees considered themselves individual craftsmen rather than members of an integrated production team. Their interests were usually limited to product quality at their particular operation and did not include the overall production quality level.

Before introducing quality control methods into any phase of production, a machine analysis chart (Fig. 3) was run on each production operation to determine what degree of precision the machine was capable of and actually was producing. Such data on average dimension $\overline{X}$ and range $\overline{R}$ as given in the control chart in Figure 3 for the honing of an inner-race bore was helpful in comparing normal manufacturing tolerances to required values and in spotting how each production machine contributed to dimensional and attributes variation.

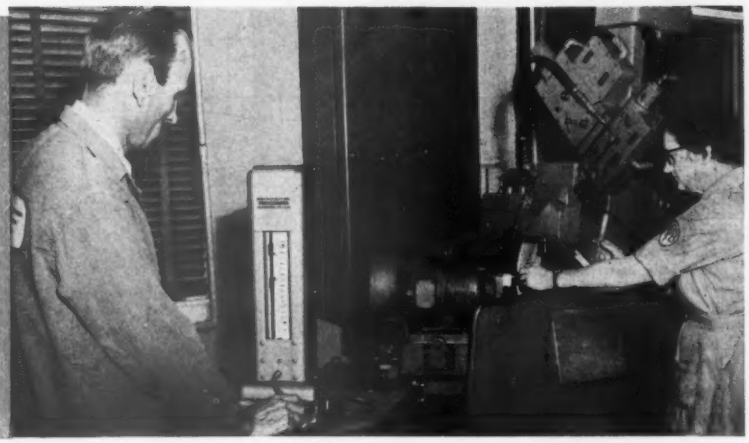


Fig. 4. At this Cincinnati Microcentric grinder station, the patrol inspector checks a flanged outer race for flange width, O.D., and out-of-roundness on the Sheffield Precisionaire gage. The gage amplication is 5000 to 1.

Receiving Inspection

Receiving inspection had been a matter of checking type and quantity of material, usually not involving any formal testing of quality. Because the quality of the material in balls and rod stock is a most important characteristic to us, a rigid system of chemical analysis was devised. Chemical analyses for each heat of material were required from suppliers and an independent laboratory was retained for comparison checks. In order to avoid mistakes in selecting materials and to prevent possible production slow-ups, a simple but effective identification system was set up and automatic inventory control instituted.

Three Areas of Investigation

There were three broad areas in which the quality level was increased (reject rate reduced) in the manufacture of miniature bearings. In relative importance of their contributions to overall improvement, these three areas were:

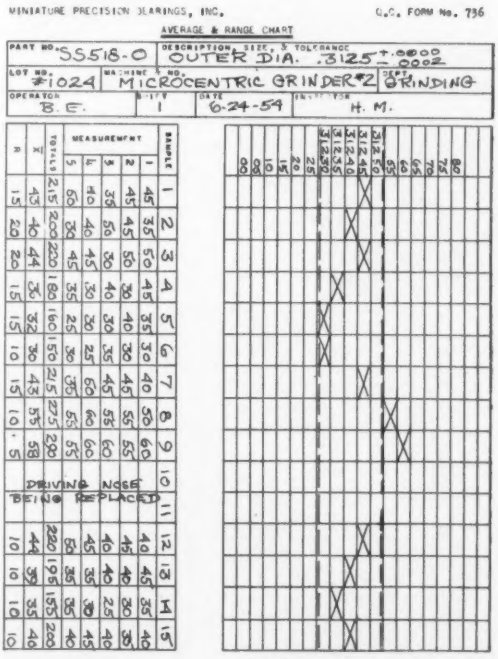
1. Changes in tool settings or operating sequences.
2. Redesign of gages and improvement in gaging techniques.
3. Training of production and inspection personnel.

The changes in tool settings and machining operations were least important simply because the number of changes were few, although each directly contributed to reduced manufacturing costs. Virtually all the operators of production machinery were very skillful in initial machine setup and operation. The only weakness, due almost entirely to a lack of formal control of production, was that the effects of tool wear and shifts in settings were often not detected soon enough.

Inappropriate gages and improper gaging techniques used at the machines were found to be the source of unnecessary rejects in a great majority of cases. Therefore, after exhaustive tests on the capability of the available testing equipment, it was necessary to adapt present equipment or design new testing devices for measuring (1) bore, (2) outside diameter, (3) concentricity of inner and outer races, (4) parallelism of faces and other important characteristics of completed races. Thus, most of the gages used by the roving inspectors from the Quality Control Department and by the machine operators in production were changed to meet specific testing requirements.

The introduction of such changes in gages

Fig. 5. Whenever a new machine is put in production, or a new bearing size or type is initiated, the production run is control-charted until setup and tool adjustments settle down to manufacturing requirements.



MINIATURE PRECISION BEARINGS, INC. Q.C. FORM No. 736

AVERAGE & RANGE CHART

PART NO. SS518-0	DESCRIPTION, SIZE, & TOLERANCE OUTER DIA. .3125 +.0000 −.0002		
LOT NO. #1024	MACHINE & NO. MICROCENTRIC GRINDER #2	DEPT. GRINDING	
OPERATOR B. E.	SHIFT 1	DATE 6-24-59	INSPECTOR H. M.

SAMPLE	MEASUREMENT 1	2	3	4	5	TOTALS	X̄	R
1	45	45	35	40	60	225	45	25
2	35	45	50	40	40	200	40	15
3	50	50	50	45	30	220	44	20
4	45	30	40	30	35	180	36	15
5	35	40	30	30	25	160	32	15
6	30	35	30	25	30	150	30	10
7	40	45	45	60	35	215	43	15
8	50	55	55	60	55	275	55	10
9	60	55	60	60	55	290	58	5
10	DRIVING NOSE BEING REPLACED							
11								
12	40	45	40	45	40	210	44	10
13	45	40	40	35	35	195	39	10
14	35	30	25	30	35	155	35	10
15	40	30	40	45	40	200	40	15

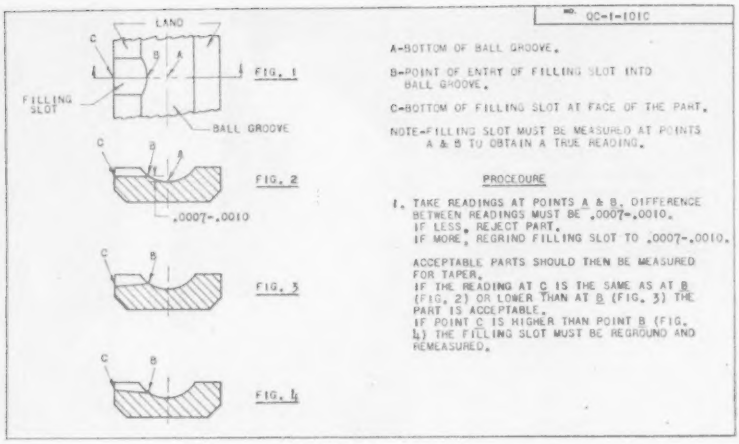

NO. QC-1-1010
LAND
C
B
A
FIG. 1
FILLING SLOT
BALL GROOVE
FIG. 2
.0007-.0010
FIG. 3
FIG. 4
A-BOTTOM OF BALL GROOVE.
B-POINT OF ENTRY OF FILLING SLOT INTO BALL GROOVE.
C-BOTTOM OF FILLING SLOT AT FACE OF THE PART.
NOTE-FILLING SLOT MUST BE MEASURED AT POINTS A & B TO OBTAIN A TRUE READING.
PROCEDURE
1. TAKE READINGS AT POINTS A & B. DIFFERENCE BETWEEN READINGS MUST BE .0007-.0010.
IF LESS, REJECT PART.
IF MORE, REGRIND FILLING SLOT TO .0007-.0010.
ACCEPTABLE PARTS SHOULD THEN BE MEASURED FOR TAPER.
IF THE READING AT C IS THE SAME AS AT B (FIG. 2) OR LOWER THAN AT B (FIG. 3) THE PART IS ACCEPTABLE.
IF POINT C IS HIGHER THAN POINT B (FIG. 4) THE FILLING SLOT MUST BE REGROUND AND REMEASURED.

Fig. 6. The Operator Instruction Sheet shows detailed drawings and step-by-step measuring procedures as well as the next action required if individual dimensions do not meet specifications. This insures conformity to the inspection standards.

and gaging technique could not have been accomplished successfully without an intensive program of education among production personnel in gaging methods, the mechanics of control charting, basic principles of statistical quality control, and the overall benefit of quality control to the company, its employees and customers. Similar training was carried on in the Quality Control Department, Receiving, Shipping, and among all employees and supervisors in all other manufacturing departments of the company.

It was frequently necessary to precede actual training by personnel evaluation and selection to obtain the most effective workers for particular testing and inspection operations. Operator Instruction Sheets (Fig. 6) were developed and issued to appropriate production personnel to insure conformity to the inspection standards.

Control Charts, Corrective Procedures Introduced at Each Manufacturing Stage

After having developed new gages and gaging techniques wherever necessary and following the beginning of the plant-wide training program, control charting was introduced systematically into each production process from initial cutting of bar stock to final inspection.

The purpose of introducing control charting throughout the plant was two-fold. First, it was important to determine the capability of the production team, i.e., the machine and the operator. Second, the actual introduction of control charting into the production process and the results obtained were used as the basis for the development of a company-wide quality reporting and corrective procedure.

As an overall objective, the actual control charting and the development of quality-control procedures provided excellent on-the-job training for both inspection and production personnel. Participation in the development of the new program by all personnel was helpful and encouraged a spirit of cooperation and real interest in improving the quality level at all stages of manufacture.

The manufacture of miniature ball bearings takes place in four stages:

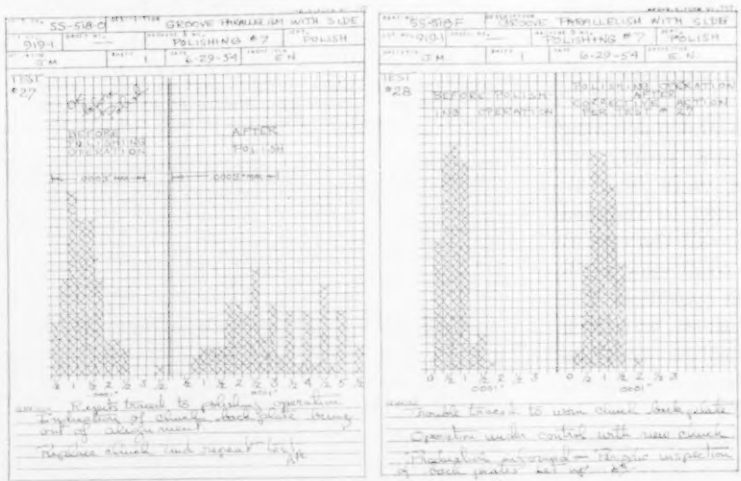


Fig. 7. The frequency distributions shown by these Q-C charts covering "before and after" tests disclosed the cause of an out-of-tolerance variation.

Fig. 8. In the third stage of manufacture, inner and outer races are measured for O. D., I. D., out-of-roundness, and taper on a Moore air gage. The gage scale graduations are in increments of 0.000050". →

1. Form inner and outer races; heat treating; width lapping.
2. Inners — centerless-grind OD and bore to size, grind ball groove. Outers — grind OD, hone bores (clean lands), grind grooves, machine filling slots. Tumble and polish raceways.
3. Gage inners and outers for selective assembly. Inspect inners, outers and balls separately and assemble.
4. Final inspection of completed bearings, washing, packaging, and shipping.

Control charting and quality control procedures were instituted in each of these stages of manufacture in succession from the forming of the inner and outer races to shipping so that the operations at each stage could be evaluated with knowledge that the product was well controlled in preceding stages.

Control Charts Now Only When Tools and Designs Change

At first, all tests and measurements for control charts were made by Inspection Department personnel at the machines. After it had been decided that control of production had been established in the first two stages of production, the regular control charting was stopped and for all normal production runs standard production procedures in first-piece inspection, patrol inspection, and control gaging were instituted. The machine operators were then responsible for periodic gaging to keep the machines in control.

In Figure 4, flange width, outside diameter, and out-of-roundness of an MPB #3 flanged outer race are being measured in patrol inspection at a Microcentric grinder inspection station. The air column gage the inspector is operating is equipped with a special fixture adaptation to handle outer rings in this size (0.1875" outside diameter) and in smaller sizes. The gage magnification is 5,000 to 1.

Of course, whenever a new machine now takes its place in production or a new bearing size or type is being manufactured, the production run is control-charted until the initial setup and periodic tool adjustment are found to fit manufacturing requirements. The control chart giving the average dimension and range for the outside diameter (0.3125" nominal) of a production run on the outer race of MPB bearing #SS518 is given in Figure 5. This type of chart is maintained by roving inspec-

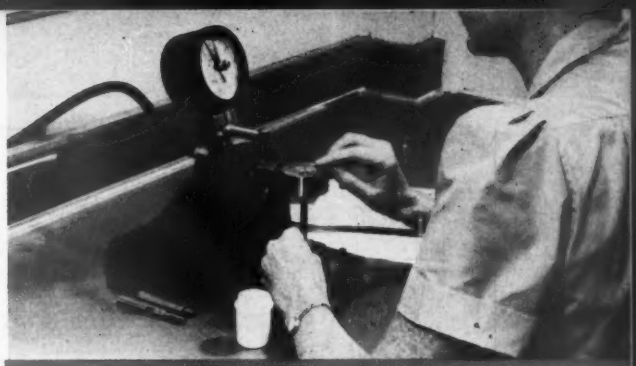


Fig. 9. This special radial clearance gage rapidly and accurately handles production line quantities of small ball bearings. The total accumulated space between balls and races in a radial direction is extremely small but must be measured very accurately.

Fig. 10. The concentricity gage, like the gage of Figure 9, was developed jointly by M.P.B.'s quality control and engineering departments. The bench center was modified to measure radial run-out of bearing inner and outer races separately. The standard for radial run-out for class # 5 bearings is 0.0002" maximum on either inner or outer race.

Fig. 11. Tiny instrument bearings are used in highly sensitive mechanisms where optimum performance depends upon an extremely low starting torque. This Bendix torque tester measures starting torque in milligram-millimeters.

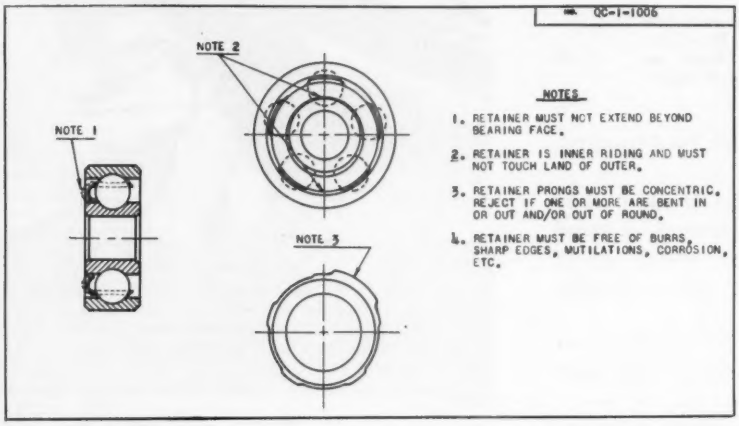

QC-I-1006
NOTE 2
NOTE 1
NOTE 3
NOTES
1. RETAINER MUST NOT EXTEND BEYOND BEARING FACE.
2. RETAINER IS INNER RIDING AND MUST NOT TOUCH LAND OF OUTER.
3. RETAINER PRONGS MUST BE CONCENTRIC. REJECT IF ONE OR MORE ARE BENT IN OR OUT AND/OR OUT OF ROUND.
4. RETAINER MUST BE FREE OF BURRS, SHARP EDGES, MUTILATIONS, CORROSION, ETC.

Fig. 12. In visual inspection a great deal is left up to personal skill and alertness, hence the necessity for all possible assists in inspection. The "visual inspection standard" shows exactly what the inspector must note in four different critical areas of concern.

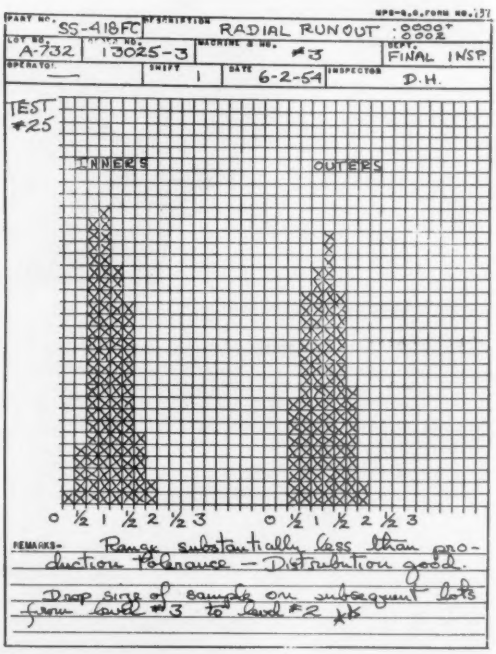
tion and, when completed, is turned over to the Quality Control Department. The information given in the chart is reviewed and any recommendations are passed on to production management.

The Operator Instruction Sheet, "Procedure For Filling Slot Measurement", in Figure 6, is a typical example of the instruction sheets issued by the Quality Control Department to aid operators and supervisors in the correct methods of inspection and measurement of each specific dimension or characteristic. The form gives detailed drawings and step-by-step measuring procedure and the next action required if dimensions do not meet specifications.

Quality Control Diagnoses Production Ills

Not the least of the values of quality control methods is the diagnosis of production problems, their solution by tracing the problems to their sources through inspection of component parts, and recommendations for corrective procedures. For example, the two Quality Control Forms in Figure 7 show how frequency distributions made before and after a polishing operation on machine #7 traced rejections to excessively wide variation in groove parallelism with side. As in the manufacture of any product, the frequency distributions made by the inspection department were designed only to pinpoint the source of the out-of-tolerance variation (for example, the polishing operation in Test #27, Fig. 7). The findings are reported to production supervision or the engineering department for permanent corrective action.

In this case, it was found that the back plate of the chuck was out of alignment due to wear. After a new chuck was installed, the second set of frequency distributions (Test #28 in Fig. 7) showed that the groove parallelism was well within tolerances after the polishing operation. Incidentally, note that in order to prevent a similar occurrence in the future, the inspection department set up a periodic inspection of the backplate.


PART NO. SS-418FC
DESCRIPTION RADIAL RUNOUT .0002
LOT NO. A-732
13025-3
MACHINE & NO. #3
DEPT. FINAL INSP
SHIFT 1
DATE 6-2-54
INSPECTOR D.H.
TEST #25
INNERS
OUTERS
0 ½ 1 ½ 2 ½ 3
0 ½ 1 ½ 2 ½ 3
REMARKS- Range substantially less than production tolerance — Distribution good.
Drop size of sample on subsequent lots from level #3 to level #2 **

Redesigned Test Equipment in Quality Control Department

The development of new gaging and gaging techniques for machine operators and roving inspectors was only a small part of the overall development of new equipment and methods. The inspection of inner and outer races separately in the third stage of manufacture and final inspection of assembled bearings involves many types of specialized test equipment which had to be redesigned to obtain maximum precision, testing speed, and optimum relia-

Fig. 13. This histographic frequency distribution is from a concentricity test of a class # 5 ball bearing on a gage similar to that in Figure 10. It serves as a final inspection record of the quality level of the lot.

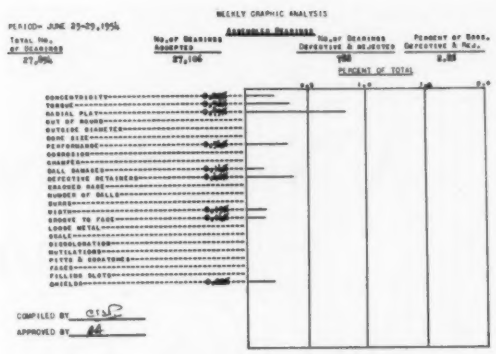


Fig. 14. The weekly graphic analysis for assembled bearings presents to management the over-all quality control picture and the reasons for rejection or rework.

bility. Again, the importance of training operators in working with new test equipment to obtain the best results cannot be over-emphasized.

Most of the following types of test equipment now used in the Quality Control Department are either entirely new or adaptations of standard precision testers:

1. Outside diameter (three types)
2. Bore of the inner ring.
3. Concentricity of the outer ring.
4. Concentricity of the inner ring.
5. Concentricity of the assembled bearing.
6. Radial play.
7. Three types of torque testers.
8. Microscopes
9. Demagnetizer
10. Metal sorters.
11. Performance tester.
12. Parallelism plus squareness gages.

The air gage in Figure 8 is used in the third stage of manufacture to measure outside diameters and bores of inner and outer races for size, out-of-roundness and taper. This gage measures in graduations of 0.000050″. The part being measured is an MPB stainless steel # 5732 super-light outer race with an outside diameter of 0.3125″ (plus 0.0000″, minus 0.0002″). This gaging, of course, precedes assembly of the bearing and final inspection.

The radial clearance gage in Figure 9 and the concentricity gage in Figure 10 are two examples of gages that were developed jointly by the Quality Control Department and Engineering Department. The radial clearance gage was developed internally at MPB since commercial gages were not available that could rapidly and yet accurately handle production-line quantities of small ball bearings. Radial clearance, the total accumulated space between balls and races in a radial direction, is extremely small but must be measured very accurately.

The bench center in Figure 10 for measuring concentricity was modified by MPB engineers to measure radial run-out of bearing inner and outer races separately. The part being tested in Figure 10 is a stainless steel MPB #418C Class #5 assembled bearing ABEC's standard for radial run-out for class #5 bearings is .0002″ maximum on either inner or outer race.

The torque tester pictured in Figure 11 is one of the several types in the Quality Control Department which are used to measure minute starting torque values. These tiny instrument bearings are used in highly sensitive mechanisms where optimum performance is dependent upon an extremely low starting torque value. In Figure 11 a torque tester is measuring starting torque of an MPB #4 shielded bearing in milligram-millimeters. MPB bearings are regularly supplied with starting torque of 1000 to 1800 mgmm.

Visual Inspection Standards

In addition to meeting many dimensional specifications set up by the AFBMA standards and within our own company, all bearings must pass a number of visual inspection standards. Visual inspection is naturally more difficult to standardize than dimensional measurements since a great deal is left up to the operator's skill and alertness. For these reasons, the proper training of operators is particularly important to insure effective visual

. . . *Continued on page 185*

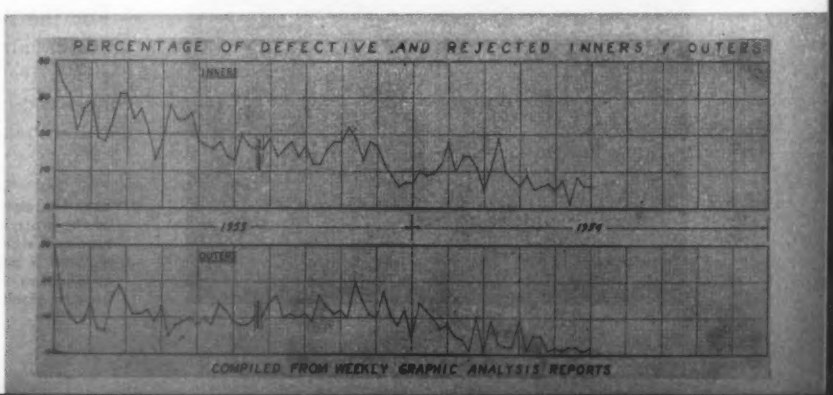


Fig. 15. Curves for percent defective and rejected inner and outer races are maintained continuously and displayed in a prominent location along with a similar curve for assembled bearings.

A New Statistical Analyzer *Simplifies* Inspection and Quality Control

by H. Dean Voegtlen, Quality Control Staff Engineer, HUGHES AIRCRAFT COMPANY

Receiving electrical signals from standard inspection and test equipment, the Statistical Analyzer classifies the data into cell intervals, tallies the measurements, and plots a histogram.

AN IMPORTANT NEW TOOL in the quality control field has recently been developed by Electronic Control Systems, Inc., (E. C. S.) which manufactures a variety of automatic factory test equipment and has long been concerned with the problem of condensing inspection and test data into easily interpreted, more usable forms.

Today there is far more data available from our manufacturing processes than we are able to use effectively. It costs money to gather information and translate it into a useful form. E.C.S. has developed a system that automatically performs many of the functions of data gathering and analysis previously done by much more tedious hand methods. This equipment is currently being offered for sale to a limited number of manufacturers in an effort to gain operating experience on how it can best be used to serve industry.

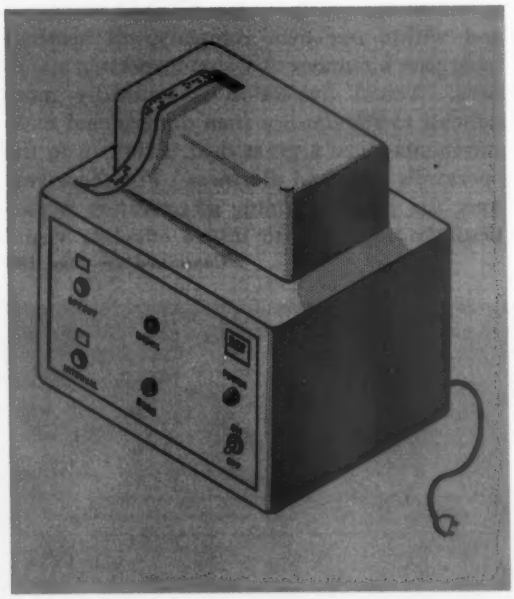


Fig. 1A. Signals from standard measuring or inspection equipment are fed into the recorder station of the statistical analyzer. The recorder classifies the received signals in terms of their relative values and delivers a paper tape punched accordingly. The recorder can be remotely located at a production or process station.

What the Statistical Analyzer Does

In the field of quality control, one of the most useful methods of presenting data is by use of a histogram or frequency tally of observed measurements. In this form, data is almost universally understood. At a glance we can tell the extent or range which our data covers; we can see where most of the values are clustered; and, with enough data, we can determine the nature of the distribution.

For the really important quality characteristics of our products such as resistance of a resistor, transconductance of an electron tube, concentration of an acid solution, diameter of a roller bearing, or weight of packaged food,

the histogram will give us assurance that we are meeting quality requirements.

But what is involved in constructing a histogram? Generally it is a fairly time consuming task. We need first to read a measuring instrument and record observations on a data sheet. Then we need to decide how many cells we would like for our histogram and assign a certain number of measurement units to each cell interval. We next accumulate the observations that belong in each cell. The last step consists of plotting or drawing the histogram from the data. Although the order may vary, the essential operations are as follows:

1. Read
2. Classify
3. Accumulate
4. Record

This can be a costly and time consuming process when performed by hand.

The Statistical Analyzer performs all of this work automatically. The basic system, shown in the block diagram of Figure 2, is divided into two separate stations for convenience. One is a recorder station, connected directly to the test equipment, that classifies the test data and records it on punched paper tape. The other unit is an analyzer station that reads the tape, accumulates the data, and plots a histogram. The recorder can be located right at the production machine or test equipment, while the analyzer can be in the office of the production superintendent, the quality manager, or at an interim data analysis location.

These two devices perform the four basic steps of data analysis enumerated above. The recorder reads and classifies; the analyzer accumulates and records. One analyzer station can serve a number of recorder stations located throughout a manufacturing area or test section. Figures 1A and 1B show sketches of the two units. Figure 3 is a typical histogram as it emerges from the last stage of the analyzer station.

How the Statistical Anaylzer Works

The Recorder Station

Functionally the recorder station, Figure 2, consists of a classifier unit and a tape punch unit. The classifier includes an automatic potentiometer and a number of relays and switches that are used for control purposes. In effect, it measures d-c input voltage received from the external test equipment or measuring instrument. Where the measuring instrument is a mechanical device, suitable electrical linkage is provided by E.C.S. to convert the measurement into an electrical signal.

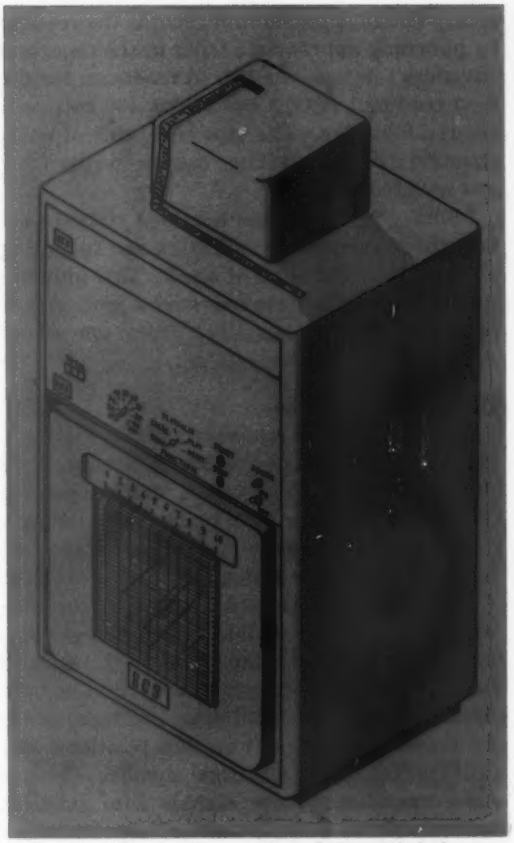


Fig. 1B. The analyzer station of the statistical analyzer is put to work by the punched tape from a recorder station. The analyzer scans the tape, generates signals corresponding to the variously located holes in the tape, groups the signals to correspond to the cells of the histogram, and makes a graphic recording in the form of a bar graph or histogram of count versus classification interval, Figure 3.

The input voltage is received and the classifier determines which step of an internal reference voltage most nearly matches the input. Sixteen steps or intervals are provided for classification of the input voltage. The normal range is 1 millivolt to 16 volts d-c, positive or negative. The classifier unit can distinguish input voltages that are above or below this 16 step range. The "too low" inputs are counted on the lowest interval, and the "too high" inputs are counted on the highest interval.

Calibrated controls permit setting the class interval size. Recording a measurement can be done by a manually operated push button that allows the test operator to record at his convenience, or it may be accomplished automatically. Using a simple relay and counter it is possible to record every measurement, every tenth measurement or any desired sample size during the testing period.

The classification circuits classify the d-c input and translate it into a four digit binary

code. The tape punch unit records the reading by punching appropriate holes in the tape, and advances the tape one line in readiness for the next reading. A tape containing 100 entries is about a foot long. The tape is capable of withstanding rough handling, can be written on, and mended if torn.

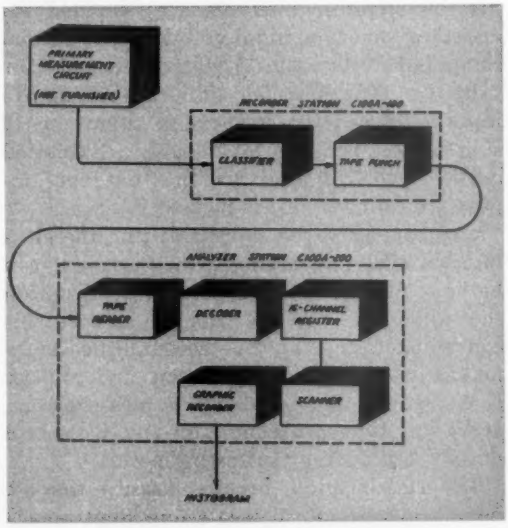
Another model of the recorder station permits the sequential classification and recording of up to four variables at once. This unit has four sets of input terminals and a multiplexer that switches the classifier from one input channel to the next.

The Analyzer Station

Functionally, the analyzer station, Figure 2, has five units: a tape reader, a decoder, a 16 channel register, a scanner, and a graphic recorder. The first two units read the data from standard five-hole punched tape; the last three units plot the histogram.

When the number of observations accumulated at a recorder station is considered sufficient for analysis, the tape is torn off, taken to the analyzer station, and placed in the tape reader. The reader will scan the tape, sense the presence of holes at various positions, and emit corresponding electrical signals. The decoder translates these signals into interval numbers (from 0 to 15) that correspond to the cells of the histogram. When the entire tape has been read, or at any earlier time, or after several tapes have been read, the operator can stop the read-in process.

Fig. 2. A block diagram of the statistical analyzer. As noted, the recorder (or recorders) can be located at a production or process measuring station. The analyzer can be centrally located to serve a number of recorders situated throughout a manufacturing area.



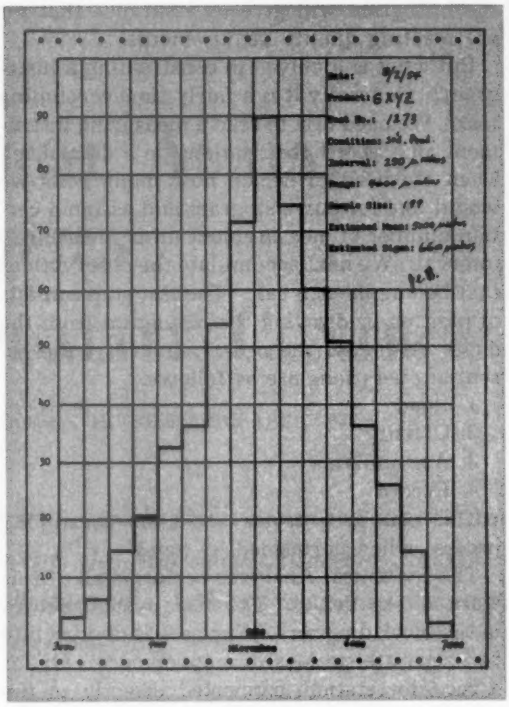


Fig. 3. A typical bar graph or histogram as plotted by the graphic recorder from data accumulated in the 16-channel register. It shows, for one style of electron tube, the transconductance in micromhos of a sample size of 199, having an estimated mean of 5100 micromhos over a range of 4000 micromhos, and in cell intervals of 250 micromhos.

Operation of the plot switch starts the read-out process and the graphic recorder. The scanner is an automatic switching device that energizes in sequence electrical read-out circuits associated with the 16 registers. These are connected to the graphic recorder that plots a bar graph or histogram, Figure 3, of count versus classification interval.

Plotting may be repeated any number of times without erasing the data stored in the registers. Data that has been plotted may be considered as a subtotal to which later data can be added. For example, successive histograms might be plotted after total counts of 50, 100, 150, and 200; or, after the histogram for the first 100 entries has been plotted, the data stored in the registers may be erased to permit separate statistical analysis of the second 100 entries. The process of reading 100 entries off the tape and plotting the histogram takes less than a minute.

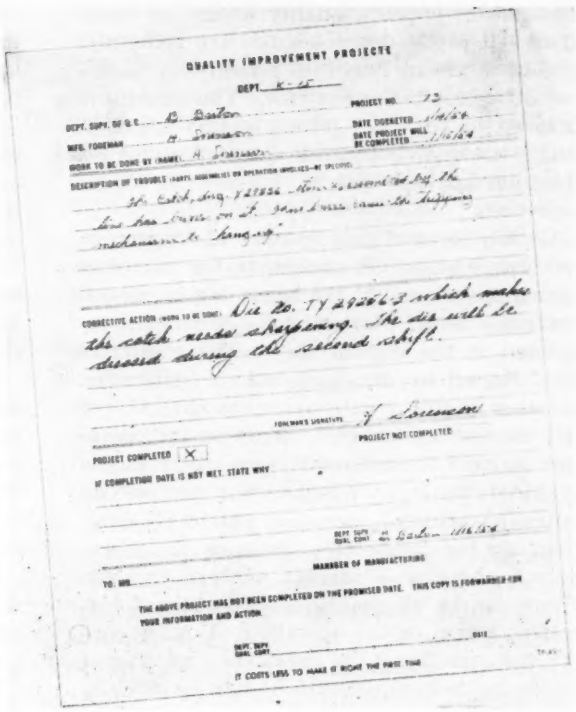
E.C.S. is planning another model of the analyzer station that will simultaneously calculate the mean and the standard deviation of the observed data. This is most useful for many statistical studies.

. . . Continued on page 182

by Joseph Manuele, Director
Headquarters Quality Control Department
WESTINGHOUSE ELECTRIC CORPORATION
Pittsburgh, Pennsylvania

QUALITY IMPROVEMENT . . .

Aim at the Bird, Not the Flock



QUALITY IMPROVEMENT PROJECTS

DEPT. K-45

PROJECT NO. 73

DEPT. SUPT. OR G. C. R. Barton

MFG. FOREMAN H. Swanson

DATE OBSERVED 11/1/54

DATE PROJECT WILL BE COMPLETED 11/6/54

WORK TO BE DONE BY (NAME) H. Swanson

DESCRIPTION OF TROUBLE (PART) ASSEMBLIES OR OPERATION INVOLVED—BE SPECIFIC)

Die Catch, drwg. 422836 Some of the parts have been out of specification.

CORRECTIVE ACTION (WORK TO BE DONE) Die No. TY 422836-3 which makes the catch needs sharpening. The die will be dressed during the second shift.

FOREMAN'S SIGNATURE H. Swanson

PROJECT COMPLETED [X]

PROJECT NOT COMPLETED

IF COMPLETION DATE IS NOT MET, STATE WHY

DEPT. SUPT. OR GEN. CONT. R. Barton 11/6/54

TO: MR. MANAGER OF MANUFACTURING

THE ABOVE PROJECT HAS NOT BEEN COMPLETED ON THE PROMISED DATE. THIS COPY IS FORWARDED FOR YOUR INFORMATION AND ACTION.

DEPT. SUPT. GEN. CONT. DATE

IT COSTS LESS TO MAKE IT RIGHT THE FIRST TIME

Fig. 1. A chart showing percent defectives is more valuable for quality control purposes if it also shows the types of defects and their frequency.

AMERICAN INDUSTRY is losing about 7.5 billion dollars annually due to defectives created during manufacturing. This is divided about equally between the cost of adjustments to customers because of product failure in the field, and the cost of scrapping or correcting defective work discovered in the shop. The question is—what is American industry doing to correct this economic waste and drain on profits?

For some industries, the answer is a flat "nothing." Some industries have made considerable progress in adapting quality control methods to their operations and thereby reducing rejections and improving quality. Tradition is largely responsible for failure to make greater progress in the more backward industries. There is a tendency to follow the crowd and if any particular plant is not doing significantly worse than the industry as a whole, its performance is considered satisfactory.

Another reason for failure to make more progress is the accounting practice of setting operating budgets on the basis of past history. Where losses due to scrap and re-operation of defectives have amounted to a certain percentage of sales in the past, that same percentage is accrued for losses in the future; and accrued expenses have a way of becoming actual expenses.

It has been stated that "you can eat an elephant, if you take one bite at a time." We have attempted to cut down the quality control elephant to bite-size morsels by looking at individual operations rather that at the performance of a plant as a whole. In doing this, we have tried to keep in mind the difference between inspection and quality control. Too often inspection and quality control are interpreted to mean the same thing. They are not the same.

Inspection is a post-mortem operation. It is used to separate the product into two categories — acceptable and not acceptacle. The product which is not acceptable is rejected and turned back to the shop foreman for scrapping, or reworking if it can be corrected. No real effort is made to analyze the defect to determine its cause; neither is there any attempt made to put pressure on the

foreman to improve quality or reduce rejections. If production schedules are being met and costs are in line with established bogies, rejections are taken in stride. This procedure assures the customer getting quality products, but is not quality control. Inspection, per se, does not improve quality, nor does it reduce rejections.

Quality control is a system of inspection, analysis, and action, applied to the manufacturing operation. At the beginning of the operation, a small portion of the product is inspected in the regular way. The results of this inspection are analyzed to determine whether quality is satisfactory or not. If it is not satisfactory, action is taken on the operation so that it will produce products of the required quality. Whether the process involves a machining operation, a molding operation, or a bench assembly operation, the procedure is the same— **inspect, analyze,** and **act.** There can be no quality control without corrective action on the operation. Quality control assumes that if the operation is capable of producing better quality, it should be made to do so.

This requires the closest cooperation between the quality control organization and the line organization. The inspector and the foreman must be in constant touch with each other and operate as a team. As the inspector inspects the product and analyzes the results of his inspection, he makes the results of this analysis known to the foreman. For best results, this must be done as soon as an assignable cause is discovered by the inspector. Then, the foreman must act to remove the assignable cause, or correct the situation responsible for the production of defectives.

Functionally, it is the duty and responsibility of the inspector to inspect the product and analyze inspection results. Administratively, it is the duty and responsibility of the foreman to initiate corrective action. He is the boss of his department and responsible for its efficient operation. Since he is responsible for making the product, he should be responsible for making it right.

This close tie between the inspector and the foreman, and the corrective action by the foreman, is the difference between mere inspection and quality control. The quality control department is constantly asking the question, "Are we doing the best we can?" If the answer is "No," then action must be taken on the operation to improve conditions in order to reduce rejections, regardless of how satisfactory results may appear to the foreman. Every assignable cause discovered must be corrected.

Control charts are often used for recording and analyzing the results of inspection. These charts also are used for informing the foreman of assignable causes which require correction. The control chart is the common meeting ground for the inspector and foreman in their efforts to control quality.

Ingenuity must be exercised by the quality control engineer in designing control charts so that they will furnish the proper information for adequate quality control purposes. Charts

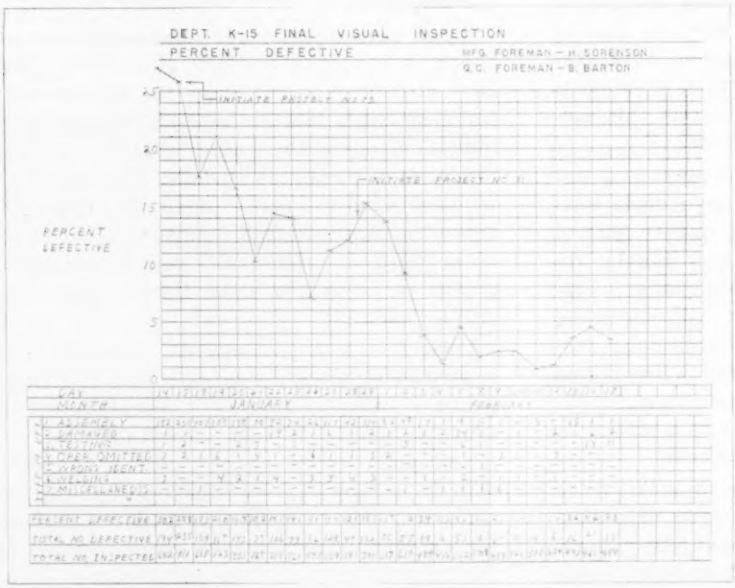


Fig. 2. This form, made out by the inspector, presents one assignable cause for the action of the foreman. If the foreman fails to act, the form is forwarded to the manager of manufacturing for his review and action.

should perform several functions. They should:

A. Measure process capability—What are the quality limits within which the process can operate consistently over a reasonable period of time?

B. Furnish running record of process performance—What is the quality record of the operation and is quality stable, improving, or degenerating?

C. Furnish information as a basis for action. Assuming that quality is not satisfactory —What is the assignable cause and what should be the corrective action on the process to improve quality?

All control charts, to be effective, should furnish the information indicated in A, B, and C, above. The quality control engineer must design all charts so they can be posted directly from inspection data and will furnish this information without causing any unreasonable burden on the inspector. Calculations should be reduced to a minimum.

Furthermore, the charts should be clear and readily understandable by inspectors and supervisors who are not skilled in statistical methods or quality control procedures. Whether it is a p-chart, an $\overline{X}$ and R chart, or a c-chart, every chart should show the types of defects being encountered and their relative frequency and importance. The chart shown in Figure 1 indicates clearly the process average, the types of defects causing rejections, and the more significant assignable causes. The frequency of occurrence of each defect is a fair indication of its seriousness. Hence, the defect occurring most frequently can be assumed to be the number one assignable cause.

The quality control engineer, when reviewing the chart, should pick out the most significant assignable cause and discuss the matter with the manufacturing foreman. In the chart shown in Figure 1, assembly defects apppear to be the assignable cause resulting in the greatest number of rejections, so the inspector brings this to the attention of the foreman. Between the two, they agree on a program of corrective action which will permanently eliminate the cause. This program of corrective action is written up on a regular form as shown in Figure 2. The defect is described by the inspector, but the corrective action is written in by the foreman.

It will be noticed that the form indicates definitely who is responsible for the action to be taken, who is to do the work, or who is to have it done. It also describes the assignable cause which is to be corrected and the work to be done to achieve this correction. It also fixes the date of completion. If the corrective action has not been completed by this completion date, the form is forwarded to the manager of manufacturing for his review and action. For this procedure to be effective, each project must be followed to completion.

When quality control programs do not succeed, very frequently the cause lies in failure to take proper corrective action as indicated by the control charts and the subsequent analyses. Hence, it is important that charts be posted as soon as inspection of the product is made. The defective units should be analyzed; the defects should be classified, and the frequency of each defect should be placed on the chart.

This inspection, analysis, and posting should be done by the inspector. However, the corrective action should be left up to the foreman, but the inspector should act as a gadfly to stir the foreman to action. If the foreman does not act in a manner which appears to the inspector to be adequate, the matter should be referred to higher authority.

Several objectives are achieved by this procedure. The most immediate and important result is reduction of rejections and improvement in quality. However, the most lasting benefits are more long range. These are the benefits resulting from closer teamwork developed among inspectors and foreman who must work together as indicated on the form.

The inspector analyzes defects and reports them to the foreman in a formal manner by means of the control chart. This requires that the foreman "do something about them." By using the project form shown in Figure 2, the foreman is confronted with only one situation —elimination of only one assignable cause. This is the bird he is to aim at. In this manner, he will not squander and waste his energies on a multitude of details. He will not aim at the flock.

Experience has shown that greater results are obtained by aiming at the bird and not the flock. It is possible to bring down the whole flock, one bird at a time. The quality performance of a large plant can be improved if each operation is analyzed by itself and something is done to bring that operation into line. Every foreman should have two or three quality improvement projects at all times. In this manner, quality improvement will receive the same attention as cost reduction, or safety—with the same results.

SOME USUAL AND UNUSUAL TOOL ROOM MEASUREMENTS with a Contour Projector*

by A. R. Fultz, EASTMAN KODAK COMPANY, Rochester, New York

LET US TAKE a look at a couple of tools that can be measured very conveniently on the contour projector but which are difficult to project. One of the most common is the screw machine circular form tool before it has been gashed. Figure 1 shows such a tool mounted on a suitable arbor on the projector work table. It can be seen on the magnified image of the tool that the circular portions of the tool are in sharp focus and their diameters can be readily measured by referring them to horizontal cross-lines.

However, it is just as important to measure the width of the various steps and the overall width of the tool. But, as can be seen, the image edges of the vertical surfaces are fuzzy and there is no definite shadow outline that can be matched to the vertical cross lines. This phenomenon is known as "wall-effect" and is found when a flat surface lies along the line of light projection. There are definite optical reasons why wall-effect cannot be overcome no matter how we arrange the lenses or the illumination.

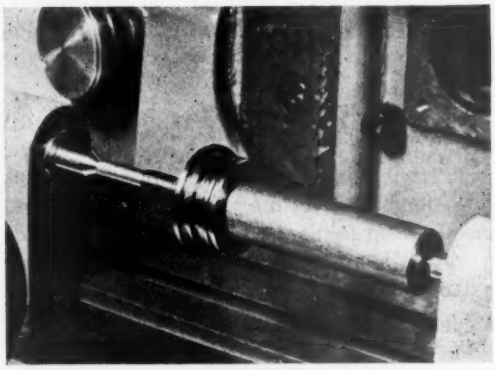


Fig. 1. Although the projected diameters of a circular form tool are sharply defined on the contour projector screen, the widths of the steps are not so easy to find. See text for a simple solution.

Attempts have been made to reduce this effect by the use of diaphragms inserted in the illuminating beam. If the diaphragm is closed down, the illumination is also reduced and the so-called wall-effect begins to disappear. A sharp image can be obtained on the screen but here a pitfall also develops. If the diaphragm has been stopped down too much, the image on the screen will grow and instead of being at a uniform magnification of say 10x it will be distorted at varying magnifications across the screen to something over 10x. Thus any measurements made will be in error.

Here is a simple safe solution. Take an ordinary toolmaker's knife edge and hold it against the vertical surface at the focal plane. The image of the knife edge is sharp and the cross line can easily be set to it. A small magnetized bar can be used in place of the knife edge so that both hands of the operator are free for measuring adjustments. The edge is located by the image of the small bar.

Another way of determining the edge of a fuzzy image is to use a pointer as on a surface gage. When the pointer is brought into contact with the surface, the true position is readily located. This method becomes particularly useful when the edge being measured

*Adapted from an address by Mr. Fultz before the 1953 Convention of the National Tool & Die Manufacturers Association. Through the courtesy of the Eastman Kodak Company and the NTDMA, we present a portion of his talk. Some of his other examples of Tool Room—Contour Projector "tricks of the trade" will be shown in following issues.—Ed.

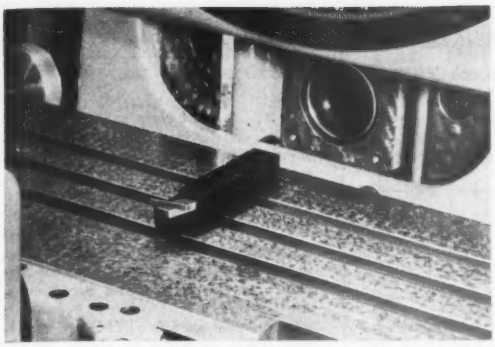


Fig. 2. The use of an "interposer" permits measurement of a surface which otherwise cannot be "seen" by the optical system of the contour projector.

is short and the knife edge cannot be easily held in position.

The single point turning tool represents still another useful trick in the use of contour projection. It is desired to inspect the tool for side rake angle. If the tool is placed on the projector table, the side rake is obscured from the optical system by the tool shank and cannot be seen on the screen. However, if a small bar, Figure 2, is placed on the side rake surface, its upper edge would be parallel to the side rake surface and above the tool shank and therefore in a position to be projected onto the screen.

Thus the side rake angle can be measured directly using the protracting ring and vernier around the projector screen. This method of using what is called an "interposer" is very useful in applications where the surface in question cannot be projected because of its position in the tool, but where its location and shape can be "shifted" by a follower or parallel that can be "seen" by the optical system of the contour projector.

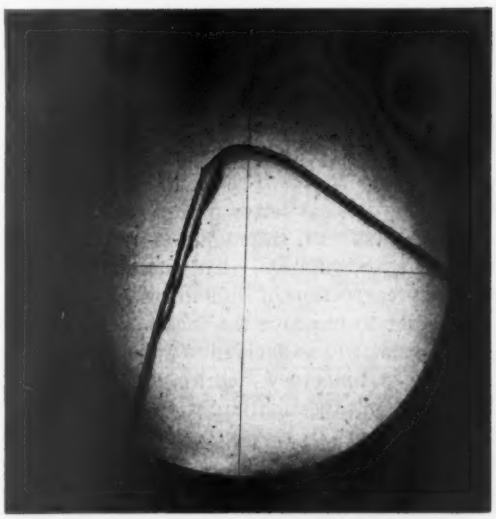
You are all familiar with the importance of clearance in punch-and-die work. Figure 3 shows the image of an x-ray film clip which has been mounted on a projector. This particular blank had to be punched with an absolute minimum amount of burrs. The blanking die was made as usual and the punch was carefully fitted to it. However, when put into use it was found that the blanks produced had small burrs on the upper points of the wings. In order to determine the trouble a piece of acetate sheeting of about 0.010" thick was placed in the punch press instead of the metal being blanked. The press was jogged so that the punch made a slight impression in the transparent material. Then the impression in the acetate was mounted on a contour projector and its image was studied. At 10x only a single line profile of the form could be seen. Actually there were 2 profiles — one of the punch and one of

Fig. 3. The projected image of a film clip which had too much of a burr condition on the upper points due to excessive punch and die clearance.

the die, but they were so very nearly alike that at a 10x magnification the difference could not be easily seen. But, with a magnification of 50x, Figure 4, an examination was made of the edges producing the burrs and a definite mismatch of 0.0035" was easily seen on the contour projector screen.

This method can be used to examine any punch and die when mounted in a die set so that uniform clearance can be determined and misalignment corrected before actually risking breakage or wall damage to the punch and die. I don't need to tell you that punch and die accuracy can be maintained for longer production runs when uniform clearance is maintained.

Fig. 4. Punch and die impression in transparent acetate showed, at 50x, the punch and die mismatch amounting to 0.0035" when the actual clearance should have been about 0.0012".



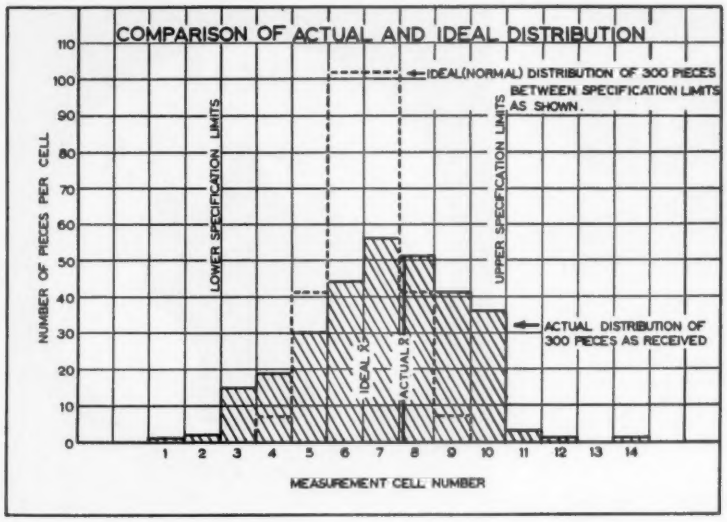


Fig. 1. A histogram made up of the actual distribution of 300 pieces as received. The pattern shows that too many pieces encroach on the upper and lower specification limits, and that some are way beyond limits. The dotted line shows an ideal distribution of a 300-piece sample, with no pieces falling beyond the limits of the fourth and ninth cells. Confronted with such a record, a vendor can recognize his necessary first steps in order to attain 100% acceptance, or the buyer may be moved to ease up on the specifications.

INCOMING INSPECTION AND VENDOR RELATIONS

*by Frank Caplan, Jr.**
Quality Engineering Specialist
GENERAL ELECTRIC COMPANY
Evendale, Ohio

IN MANY ORGANIZATIONS, Incoming Inspection practices follow a similar pattern which will be described below. Although this system affords a certain amount of protection against poor material getting into production operations, it does not go very far toward insuring that future lots of the same material will be of any better quality.

As each lot of material comes in from the vendor, it is inspected according to an AQL sampling plan. Accepted material is placed in stock. Rejected material is submitted to the floor engineer concerned for his examination and possible acceptance. If this engineer feels that the material can not possibly be used, the material is set aside to be returned to the vendor and the purchasing organization is notified of this disposition. Purchasing then notifies the vendor and arranges for ultimate disposal of the parts. Frequently, this is handled by a general letter discussing the shortcomings of several shipments of material. This method offers relatively little assurance of the ultimate correction of difficulties.

In order to improve the incoming quality of all material, it was decided to attempt to set up a more satisfactory working arrangement. Early in the investigation, it was decided that it would be necessary to contact each of the major vendors with a request that they send representatives to the plant to discuss all of the items they were then manufacturing.

In preparation for these interviews, histories of the parts for the previous year were compiled. These showed the number of pieces received, the sample size, the number of rejects in the initial sample, and the reasons for these rejects. This was done for every part. In many cases where measurements were involved, frequency distributions were constructed on measurements of the material in storage to show just how these quantities varied. The total amount of accumulated information gave a very clear picture of the area of difficulty.

Figure 1 shows a typical frequency distribution of a dimension on a part compared with the distribution we should expect on this dimension. The indication was obvious that the vendor was making considerable material outside of our specifications and was being forced to sort his production in order to meet our standards. Even so, a proportion of the material

*When Mr. Caplan wrote this article, during the past summer, he was Process Quality Control Supervisor, General Electric Company, Syracuse, New York.

in excess of specifications was getting through his inspection procedures and reaching us. This, obviously, was expensive to both of us and could only be resolved by our relaxing the specifications or by his improving his production methods and controls.

As a first step toward a better program, a committee was set up to examine the specifications and tolerances on every part. This committee was composed of the pertinent floor engineers, the Supervisor of Process Quality Control, the Supervisor of Process Engineering, and the Incoming Inspection Foreman. In many cases, it was found that specifications could be relaxed and tolerances widened without any harm whatsoever to the function or assembly of the parts.

Wherever possible these specifications were relaxed to include somewhat more than the full spread of the vendor's production. In many cases, of course, this could not be done; but by this procedure the areas where the vendor would have to make adjustments in his process or equipment were considerably reduced in number. The vendors found this information to be very worthwhile since it gave them the complete picture of the troubles which had been experienced with their parts and, in many cases, forced them to alter their concept of the relative importance of various dimensions. Frequently, it was found that the vendors had been emphasizing control and accuracy on dimensions which were not nearly so critical as others which they had not considered important at all.

Following these meetings, a new procedure was set up. Every print was to be marked in such a way that the relative importance of the various dimensions and characteristics of the part would be obvious.

Such dimensions or characteristics would be categorized as Critical, Major, Minor, or Incidental. This would provide the vendor with considerable additional information initially, and would preclude extended correspondence to work out the relative importance of these quality characteristics.

As each incoming lot is received from a vendor whose previous history justifies it, it is inspected on a warning sample basis. Twenty-five pieces are taken from each lot and examined for all classified characteristics. All dimensions measured are recorded on the form shown in Figure 2, "History Report of Metal Parts."

Attribute defects are tabulated according to the four categories. When such defects are found an additional sample is taken and inspected for those particular defects until the total number inspected is that required by the applicable AQL sampling plan. The results of inspection are tabulated on the inspector's report form, a copy of which is immediately dispatched to the vendor. This copy does not show the ultimate disposition of the lot, merely the results of the inspection. Thus there is no delay in reporting to the vendor the quality of each of his shipments, and sufficient information is included in this report to enable him to take immediate corrective action.

In order to determine whether or not the vendor is actively attempting to improve his quality, a history chart is maintained on every purchased part showing the lot-to-lot history. This gives a continuing record which can be consulted at any time by the purchasing organization to determine punitive action or to assess the relative quality of operation of two different vendors in order to determine where best to place future orders.

To assist in this area, an over-all Quality Audit Score is maintained for each vendor on a monthly basis. This is calculated from the information filled out by the inspector on the form shown in Figure 3, "The Vendor Quality Control Audit Record." A scoring system was devised tending to show the relative importance to function of each of the different categories of defects.

HISTORY REPORT OF METAL PARTS

Vendor_____

Part No._____ Part Name_____ Insp.___ Acc.__ Rej.___

Date Inspected_____ Quantity_____ Sample_____

Dimensions Checked

	1	2	3	4	5	6	7
1.							
2.							
3.							
4.							
5.							
R							
6.							
7.							
22.							
23.							
24.							
25.							
R							

1. $\bar{R}$___ $\bar{x}$___ $\sigma = \frac{\bar{R}}{2.326} =$ ___ 5. $\bar{R}$___ $\bar{x}$___ $\sigma = \frac{\bar{R}}{2.326} =$ ___

2. ___ ___ ___ 6. ___ ___ ___

3. ___ ___ ___ 7. ___ ___ ___

4. ___ ___ ___

Fig. 2. The "History Report of Metal Parts" is used to record the findings when inspecting "warning samples". It serves to speed up reporting to the vendor and includes sufficient information to enable him to take immediate corrective action.

It is from this score that the audit is compiled. On certain specific measurements, which were extremely important to function or where considerable difficulty had been experienced in the past, the twenty-five measurements taken for the history report, Figure 2, were to be used to maintain variable control charts by plotting the average and standard deviation of the twenty-five piece samples. These would give an excellent indication of lot-to-lot quality as well as that of the given lot.

Some of the advantages of this new system are, first, it offers savings due to reduced sampling efforts in cases of very good or very bad quality. Since the number of defects found in a twenty-five piece sample taken from a bad lot may exceed the number allowed in the AQL sample, it would not be necessary for our purposes to take the larger sample. And obviously, where no defects were found in the twenty-five piece sample, no further inspection would be necessary.

Second, by using this uniform sample size in keeping the records described above, it is possible to provide an accurate picture of vendor quality over a period of time. This should eventually serve to assist the purchasing department in determining which vendors could be placed on an approved list.

Finally, since each vendor would be provided with lot-to-lot information on his product, liaison with him would be much better on quality problems of any description.

In developing a system of this sort, the following steps are necessary. First, a careful study must be made of the history of each part, where this information is available. If it is not readily available, such information will have to be gathered before any further steps can be taken.

Fig. 3. The "Vendor Quality Control Audit Record" provides the information for keeping an over-all Quality Audit Score for each vendor on a monthly basis. The scoring system is based on the relative "importance to function" of each of the different categories of defects.

Vendor Quality Control Audit Record

PART NO.

VENDOR AUDIT

TALLY PAGE DATE INSPECTOR

	ZERO SAMPLE	SAMPLE SIZE	AQL	DEMERITS
NO. CRITICAL DEFECTS			X50	
NO. MAJOR DEFECTS			X25	
NO. MINOR DEFECTS			X10	
NO. INCIDENTAL DEFECTS			X1	
			TOTAL	

VENDOR AUDIT 1000 − [DEMERITS / SAMPLE × 100] = _____

Having completed this analysis, it would then be necessary to review all specifications to determine just how realistic they are. Alterations in these specifications should be made in those areas causing the least difficulty both to the vendor and to the factory. Where possible, without harming ultimate quality of the manufactured item, or hindering the assembly of parts, specifications should be relaxed to permit easier operations and simpler control by the vendor.

When these two steps are completed, or perhaps during the second step, it is necessary that a mutual understanding be reached with the vendor so that he will be interested in working on the problems as they are identified.

In the operation of the system, six basic forms have been found necessary to permit ease of operation and record keeping. The first is the Print or Drawing of the part showing all dimensions, specifications, and the categorization of each dimension or characteristic. This enables everyone involved to have available at all times a picture of the relative importance to end-quality of the various aspects of the parts.

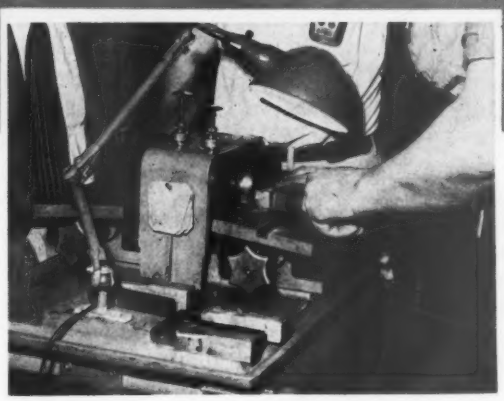
A sampling record sheet (History Report of Metal Parts) was developed which is used as a tally sheet for the inspector. It shows at a glance the results of measurements on any given lot. From figures on the sample record sheet are plotted Control Charts where it is decided that these are needed.

Also, a Vendor Quality Audit Record Card was made up showing the calculation of the quality audit score, and giving a ready reference for any future questions as to problems with a particular lot. From this card is plotted the Vendor Quality Audit Graph showing the lot-by-lot quality and the over-all vendor quality.

In addition, a Vendor Lot Quality Report form was developed, identifying the lot by number, and showing in tables and frequency distributions the actual result of the inspections. A copy of this latter form is used as the notification form to the vendor.

It is felt that this approach to the mutual solution of the problems which are everywhere experienced with purchased parts will result in a rapid and permanent improvement in the over-all quality of the processes of both the cusomer and the vendor.

Diamond Lapping Improves Life of Carbide Tools



Producing a superfinished edge on a carbide tool. "Hyprez" diamond compound is applied to the rotating lap by means of the applicators seen on top of machine housing.

A JOINT UNDERTAKING by an industrial supplier and an aircraft manufacturer in the diamond lapping of carbide tools resulted in very worthwhile step-ups in productivity (increased speeds and feeds) as well as extended tool life between grinds.

A carbide tool lapping machine was put into service in the Torrance facility of Douglas Aircraft Company's El Segundo Division by the Garrett Supply Company of Los Angeles.

The supplier briefed Douglas production men on what to expect of diamond lapped tools, and instructed tool grinding personnel in the use of the equipment. It was shown how, with the use of appropriate "Hyprez" diamond lapping compounds, a superfinish could be imparted to the cutting edges of the tools. Superfinishes with the surface "hills and valleys" held to 1 micro-inch in depth were attained.

It was at first planned to superfinish only those tools used on the more severe airframe machining projects but results of the earliest runs justified setting up to diamond lap all single point tools.

On various Douglas Aircraft jobs the tools were run on "Borematics", tracer-equipped lathes, and turret lathes. The diamond lapped tools produced more parts, with better finishes, and held closer tolerances per tool.

In the case of a Sidney hydraulic tracer-controlled lathe turning 4" O.D. steel, heat treated to a tensile of 180,000 — 220,000 psi, a Carboloy D-12 tool with a chip breaker was taking a cut 18" long and 0.273" deep. It required three and sometimes four cuts to complete one part, and only three to five pieces were being delivered per grinding of the tool.

After the tool was diamond lapped to a superfinish, only one cut was needed to complete each part, and 11 to 16 pieces could be produced between grinds. To step up production of the landing gear wheel cylinders even more, the rpm of the machine was raised from 172 to 390.

A boring operation on a Jones & Lamson No. 5 turret lathe was removing 0.040" stock for a length of 8". The machine was being operated at 734 rpm and 0.011" feed. After diamond lapping the tool, this job was stepped up to 1041 rpm and 0.015" feed with a substantial increase in tool life.

On a turning operation on the same machine, rpm went from 510 to 734, and feed was increased from 0.011" to 0.015". Additionally, the superfinished tool was able to produce 172 pieces per grind as compared with 59 for tools finished the old way.

Results on aluminum castings were equally impressive. A Warner & Swasey No. A-1 turret lathe turning engine mount fittings cast from 75 ST aluminum had a record of 25 to 30 pieces per tool grind. After superfinishing this jumped to 206. Rpm at the same time was stepped up from 296 to 504, and feed was increased from 0.008" to 0.011". Depth of the cut was 0.250" for a length of 3.125".

A TYPICAL CASE

Machine: Warner & Swasey No. 3 Turret Lathe
Tool: WS-3. Carboloy Roller Turner
Stock: 4130 Steel Hex Bar
Job: Turning 1½" diam., 5.125" length of cut; depth, 0.093"

Before Diamond Lapping		After Diamond Lapping	
Spindle Speed:	352 rpm	Spindle Speed:	740 rpm
Feed:	0.007"	Feed:	0.018"
Pieces per grind:	34	Pieces per grind:	152

Besides the increased speed and tool life, idle machine time for tool changes, setup and adjustments was substantially lowered, and it was found that the cutting edges of diamond lapped tools chipped and cratered less.

Air Power FOR METALWORKING . . . VII

NOTES ON AIR GAGES AND AIR GAGING

. . . gathered by the editor

FOR A MOST satisfying definition of air gaging we will quote David B. Kirk, Chief Engineer, Moore Products Company. In an illustrated lecture, "Introduction to Principles of Pneumatic Gaging", presented under the auspices of the Production Engineering Division at the 1952 annual meeting of the American Society of Mechanical Engineers, Mr. Kirk said:

"Pneumatic gaging, as its name implies, is a means for measuring dimensions by the use of air. More specifically, in a pneumatic gage, the proximity of a surface is measured by a jet of air directed toward it by a nozzle which never touches it. The restrictive effect, produced as the surface approaches the nozzle, has a well-defined relation to the clearance between the two. This effect may be measured by any of several conventional pneumatic systems.

"Pneumatic gages have a number of distinguishing features. Foremost among these is the ability to measure a dimension without touching the surface. As a result of this feature, the gaging nozzles of a pneumatic gage may be expected to have a very long life. The absence of mechanical contact also makes it possible to measure soft or highly polished surfaces, which would be deformed, or damaged, if hard mechanical contacts were used.

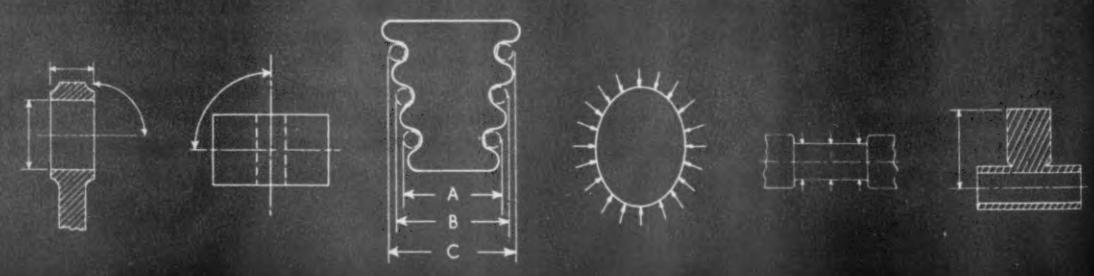
"A second important feature is that the jet of air has a tendency to clean the surface of the part at the point being measured. Thus, it is possible to make an accurate measurement of work which is coated with dirt, grease, cutting compound, or abrasive particles."

There are only a few air gage manufacturers. They all make good gages and, being wholehearted exponents of free enterprise, each believes that he makes the best and will go all out to prove his claims.

There is one point, however, on which they are all in unanimous agreement; and that is that the one thing they all need for the successful operation of their air gages is good clean and dry air.

Here is what Pratt & Whitney has to say:

These symbolical depictions of air gaging setups courtesy



"For maximum performance we suggest consideration be given to the main air supply system and offer the following suggestions:

1. Install after-cooler on the compressor. This is equipment which is available from all of the compressor manufacturers, and works on the principle of counterflow of cooling water.

2. The main air supply line should be connected to a primary filter and water trap and a primary regulator. We recommend the Adams Porostone Filter and Water Trap with ¾" filter and ½" water trap. In the event that a very large number of gages is used, this can be obtained in larger sizes, although it is probably better to have additional units. One such installation, as suggested, will be sufficient for handling approximately three or four dozen gages. The primary regulator should be set at about 75 psi, and we recommend a Cash Regulator specified as ½" Class D Single Seat Pressure Reducing Valve for Air Service. This also can be obtained in larger sizes, if necessary.

3. Connections to the primary filter should be made from the main line so there is no drainage. In other words, it should be taken from a riser or from the top of a horizontal line.

4. The line from this primary regulator should be used for pneumatic gages only, and not for cleaning or blowing out chips on machined parts.

5. Connections from the feeder line from the primary regulator should be taken off a riser or from the top of a horizontal line so that there is no drainage to the gage.

6. The regular procedure of periodically blowing off the filter in the gage itself should be put into effect."

The Federal Products Corporation advises "Ordinarily, clean air lines cause no trouble to air gages. However, many air lines are dirtier than realized, and are loaded with oil and water. Such a condition will affect any air gage." The installation instructions which accompany Federal Products Corporation gages, in addition to specifying that the branch air lines to the gaging stations be taken from the top side of the main feed pipe, also show that long turn bends in the branch piping are "preferred", with an arrangement of ells and nipples designated as "acceptable." A branch outlet from the bottom of a feed line is, of course, wrong inasmuch as it would invite any entrapped oil or water.

Further emphasis of the necessity for a supply of clean, moisture-free air is found in the installation instructions issued by Moore Products Company, i.e.

"The gage air lines should be separate from the factory air line, running directly from the compressor. A chemical dryer is recommended on large installations, to reduce maintenance problems.

"Connections to air lines should be at the top of risers or away from horizontal sections

Courtesy The Sheffield Corporation.

Twelve internal diameters within an automobile transmission body valve (insert) can be inspected simultaneously on this multiple-column air gage. From the work holding and locating fixture, six air spindles connect to the 12-column Precisionaire. A half-turn of the crank handle brings the spindles into contact with the work, and, instantly, the column floats show which diameters are within tolerance or how much they are oversize or undersize. Two of the air spindles are of the "step" type and have two sets of orifices to check two different diameters when in gaging position.

The Taft-Peirce Manufacturing Company.

in which dirt, oil, and water may collect. Pipe compound should be used very sparingly and should be applied only on the male threads. Scale-free piping or copper tubing is recommended.

"Before making any connections, blow out the line thoroughly, using maximum supply pressure, to remove all dirt, oil, and water. Before connecting the gages, blow out each section of the line again. (These precautions will reduce the possibility of service interruption, especially at the beginning of operations.)"

* * *

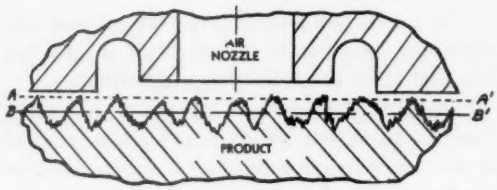
The "averaging effect" of air gaging is of considerable importance. Mr. Kirk, in his lecture referred to above, offers the following on the averaging effect and its relation to the gaging of workpieces having rough surfaces:

"Pneumatic gages measure the average dimension over a small area, rather than the dimension at a point of contact—as is the case with many mechanical gages. For this reason, the curvature of the master setting gage must duplicate the curvature of the measured part. For example, a two-nozzle plug gage cannot be calibrated by means of flat surfaces such as those obtained with a stack of gage blocks. The difference between the curvature of the cylindrical bore and the flat masters would cause serious errors—especially for small diameters. One apparent exception to this general rule is found in the wall-thickness gages, which may be set with flat masters—even though these gages are used to measure cylindrical walls. The reason for this exception is that the convex and concave surfaces on opposite sides of the part have compensating effects, if the thickness of the wall is small, compared with its radius.

"Because of its averaging effect, the pneumatic gage will not indicate the same dimension of a rough surface as will a mechanical gage. A mechanical contact gage measures to the peaks of the surface, whereas a pneumatic gage shows the average dimension of the surface under the nozzle. If the surface finish is rougher than approximately 50 microinches, the discrepancy in the readings between the two types of gages may be objectionable. Pneumatic gages are, however, adaptable to the measurement of rough surfaces, through the use of intermediate mechanical contact members which control the discharge of the air from the nozzles."

Most air gage manufacturers offer contact nozzles, in addition to the "open" style of nozzle, to handle measurements between relatively rough surfaces. Contact plugs vary in design details but essentially they provide a means for the air stream to "ride the peaks" of a hill and dale surface, so that as the peaks

. . . Continued on page 220



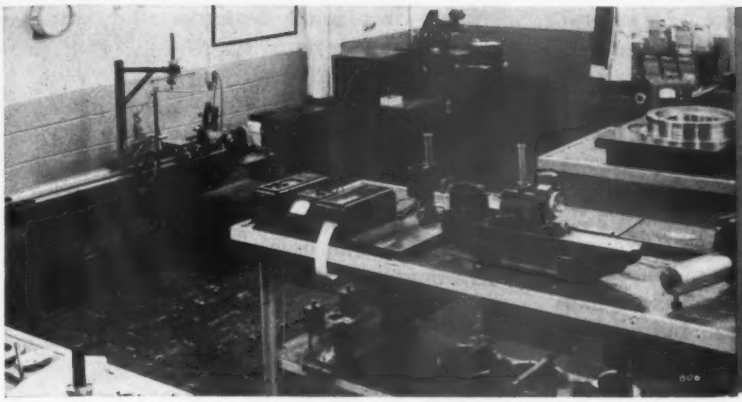
(above) Large scale schematic showing relation of air nozzle to a relatively rough surface where A-A' represents average height of surface peaks, and B-B' shows the average height of the finish profile. (Editor's note: this diagram suggests a question: could an air gage be designed to measure the pitch diameter of a fine thread? No charge for the idea!)
(below) The diametral measurement differences attributable to a range in RMS surface values of from 10 to 100.

RMS VALUE	DIFFERENCE	RMS VALUE	DIFFERENCE
10	.000025	60	.000165
20	.00004	70	.0002
30	.00008	80	.000225
40	.00011	90	.000255
50	.00014	100	.00028

Courtesy Pratt & Whitney Division Niles-Bement-Pond Co.

Photo courtesy Mead Specialties Co.

This special Merz New-Matic gage checks both taper and out-of-round in one fast and accurate operation. The gaging fixture has a ball-bearing ring that conforms to the large calculated diameter of the taper. The small calculated gaging diameter enters a second ring which "floats" vertically and activates the air flow. The right-hand dial shows variations of the taper angle to plus or minus 10 minutes in graduations of 1 minute. To show out-of-round, a ruby-tipped pick-up pin is located between the upper and lower gaging rings. By turning the part being checked in the ball-bearing ring, out-of-round is read on the left-hand dial in 0.0001" to a total of 0.002". The master plugs shown serve for setting and periodic checking.



The measuring laboratory, held to a constant temperature and humidity, is available to every operator for a recheck of any borderline or questionable gage.

A Gagemaker's Concept of Quality Control

WHAT IS QUALITY CONTROL? Obviously, in its simplest terms, it is the control of quality. If this is true, then any control which helps to produce an end product to the specifications required by the designer is a quality control.

Applying this simplest of definitions to our own problem led us to look for the simplest, quickest and most direct method of control. We have found it. Right between our operators' ears.

Ours is a high precision product, the tolerances are extremely close, the quantities are usually small, and service to the customer — i. e. quick delivery — is of the utmost importance.

The main problems were three. Three that are common to most manufacturing plants — high costs, high scrap, and low morale. These three seemed to us to be interrelated, and the first two were apparently built on and were a result of the third.

This low ebb of morale had permeated every department. For example, it was never the fault of the production department that deliveries were delayed and the product made incorrectly. According to the shop, it was always because the engineers had held up their drawings too long and had failed to give complete or correct information to the shop. In turn, it was not the engineering department's responsibility — they claimed the sales-order group had sat on the customer's orders, and then when they were finally released the requirements were not made clear.

These groups had gone round and round in this vicious circle so long that, as so often happens in too many cases, the issue became a personal one, and morale went further down.

In analyzing our quality control problem, and trying to plan a remedy, it seemed that all these factors were important and were so closely interwoven that they must all be attacked at once.

We worked from the premise that the shop — the manufacturing department — was the basis of our operation, and that all other departments — sales engineering, cost-accounting, etc. — were, in our final analysis, merely service adjuncts to the main operation — the production of quality gages.

You who have dealt with prima-donna's from drawing boards to typewriters can, perhaps, understand our difficulties.

The first approach was a meeting of the entire group, from the floor sweepers to the private secretaries. This took the form of a general discussion, not of our problems as such, but of our aims and our hopes for the future. This led easily and naturally to the subject of quality and precision. At the same time a great deal of interest was engendered in the related subjects of costs and methods.

by C. V. Briner
Manager, Gage Division
THE PIPE MACHINERY COMPANY
Wickliffe, Ohio

These meetings, of which there were several, while they developed a certain cost and quality consciousness, did not pin point our quality goal.

They did, however, develop a somewhat better spirit of cooperation and paved the way for a final move.

We had felt for a long time that the ultimate quality control lay in the minds of our operators and that it was only necessary to enlist those minds, to develop a pride in craftsmanship among our workers, to attain our ends.

The final impetus was given and the decision reached to give it a try in a discussion on the job with a group of gage finishers. These are the men who regularly work to tolerances of a few millionths of an inch. This was the department where our rejects and our inspection costs were highest. It was also where our morale was lowest.

We were told, in this discussion, by one of our operators, that the difference between an article of use and a masterpiece — in our case, between a gage and a master gage — was that one was made working with the hands, the other by working with the mind and the heart.

What more could management ask? Nothing at all — if they would be willing to assume all responsibility for the quality of the product they produced. Would they be willing to be the guardians of their company's reputation? By this time they were beginning to feel that it was their company. The answer was yes.

This small group was given that responsibility at once. When they finished their last operation, the product was shipped without further check. They were honest men and women (are there any other?) and they assured their company that the gage they had made and certified was correct.

How did it work? Fine. What was the total result? A remarkable decrease in scrap. A larger decrease in customer rejects. But, best of all was the almost unbelievable boost in spirit.

From this small beginning the idea has spread to every department in our gage division, with equally gratifying results.

Each operator has at his station, of course, adequate inspection equipment with which he is thoroughly familiar. In the manufacturing areas, this equipment consists of various thread measuring equipment as well as the usual compliment of linear and hardness measuring instruments.

Checks are made for diameter, lead, drunkenness of thread, angle, out of roundness, finish, hardness, etc.

When the machining is satisfactorily completed, the gage goes directly to the finishing department. If an error is discovered at machining, the gage is scrapped at machining, and no penalty is imposed. However, if — and get this—if in the judgement of the operator an incorrect piece could be salvaged in the finishing operation, it is suitably tagged to alert the final finisher that extra care must be used on those particular pieces. (These are honest men and women — there are no other.)

The finishing department, which is air conditioned, is also completely equipped with the inspection equipment needed to assure the final accuracy of the product. Here the product is checked as received, checked while in process, and finally approved for shipment by the operator who does the work.

We do maintain a measuring laboratory where a constant temperature with proper humidity prevails. This is available to every operator for a recheck of borderline or questionable gages.

If the gage is of such a nature — because of size or of unusually close limits — that temperature changes would affect the final size, this laboratory is used, of course.

A staff of competent inspectors is on duty here constantly, using the very finest of measuring equipment, but they are our entire gage inspection crew.

. . . Continued on page 215

In the gage finishing departments each operator's station is equipped with all the measuring equipment essential to assuring final accuracy.

MAGNETIC COMPARATOR TESTING OF STEEL CARTRIDGE CASES

*by S. S. Rice**
Assistant to the
Manufacturing Vice President
EKCO PRODUCTS COMPANY
Chicago, Illinois

This discussion by Mr. Rice illustrates some of the ways in which Magnetic Comparator Testing is being put to profitable use. While the description is in terms of cartridge cases, the same non-destructive testing methods can easily be adapted to many other products.

WE WOULD INDEED MARVEL at an instrument which, when brought into proximity, but not into actual contact, with a suit of clothes, could tell us the percent real wool in the suit, the way it would keep a press, or how long the suit could be expected to last. Yet, in magnetic comparator testing as applied to many iron and steel products, we have an equally versatile, non-destructive means of examination and testing.

Magnetic comparator testing is being used extensively at Ekco Products Company in the production of steel cartridge cases. By applying the proper magnetic test methods to the completed cartridge case, we can actually determine many of the characteristics it will show during firing; and, by applying these very same test methods to various operations performed during the manufacture of the case, such characteristics can be predetermined and carefully controlled. Not only is such testing rapid and non-destructive, but once set up it can be performed by any employee with a few minutes of instruction.

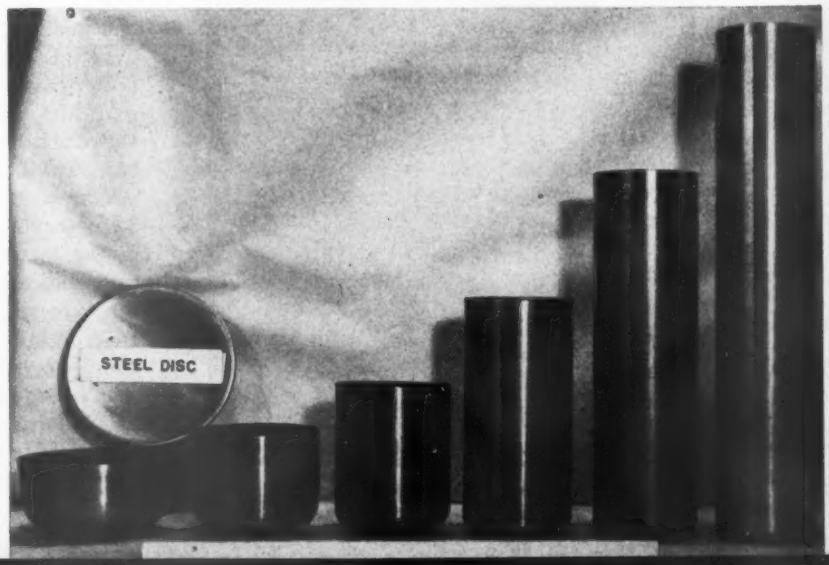


Fig. 1. Typical blank, cup and draw sequence in press production of a steel cartridge case.

The Steel Cartridge Case

Today we are in a transition period in cartridge cases. We are converting from brass to steel. As early as World War II, cartridge cases of a few different calibers were made successfully in steel. While tooling, annealing, and other factors had to be carefully adapted to the use of steel, the over-all method of production was fundamentally the same as

*This article is based on original development work in which the author participated while Chief Metallurgist of Ekco Massillon Division, Ekco Products Company, Massillon, Ohio.

that applied for years in the production of brass cases. A blank or disc was sheared from the hot-rolled steel strip. This blank was then cupped and drawn deeper and deeper until proper length was obtained (Fig. 1). Each draw was preceded by a process anneal to soften the metal for further cold-working.

Because of certain metallurgical differences between steel and brass, some of the physical properties of the steel cartridge case had to be far superior to those of the brass case to do an equivalent job upon firing. It soon became ob-

Also see "Steel Cartridge Cases . . . their Cold Forming and Heat Treating", by S. S. Rice; Tooling & Production, December, 1953.

vious that cold-working alone would provide sufficient strength **only** for steel cartridge cases designed to be fired at relatively low pressures. Steel cases required to perform at high pressures had to have even greater strength.

The need for this greater strength has been met by the application of heat treating once the case has been drawn to full length.

Because of the unusual physical demands (of impact strength, tensile strength, yield strength, and elongation) made upon a cartridge case, extreme care must be taken in its manufacture. It is not enough that **most** of the cases meet certain standards. Any individual case could be a matter of life and death to the gun crew. Controls must be set up at all critical operations. In addition, there must be a way to check every completed case rapidly and non-destructively. In this control work we employ many tools, perhaps the most widely and successfully used being magnetic comparator testing.

Fig. 2. Magnetic comparator test setup for checking lower sidewall of cartridge case.

Magnetic Test Equipment

Our magnetic test equipment is relatively simple in design and low in cost. An entire unit, consisting of a magnetic comparator together with the necessary test coils, costs well under $1,000.

The magnetic comparator is enclosed in a portable case on which are mounted the control knobs and the indicating instrument. The control knobs permit varying the circuit voltage to vary the degree of magnetization of the pieces being tested; varying the sensitivity of the indicating instrument; and adjusting the balance of the equipment. The test fixtures consist of two identical coils. One of these we label "fixed", for use with a reference specimen; the other "variable", for use with the pieces being tested.

Certain properties affect the magnetic flux linkages induced in the coils by the specimens. The cartridge cases are tested by comparing (1) the effect of unknown cases upon the inductance of the coil with (2) the effect produced upon the coil by known cases. The difference in inductance is registered on a 200 microampere, center zero instrument.

The procedure for setting up the equipment is essentially the same no matter what the job to be done. A reference specimen of approximately the same size and shape as the pieces to be tested is positioned in the "fixed" coil so that the area to be tested lies within the coil enclosure. The instrument is then balanced so that the readings on the samples to be tested in the "variable coil" will fall within the indicating range of —100 to +100. The circuit voltage is selected that will best test the property in which we are interested. Each specimen can now be tested by simply inserting it into the "variable" coil (Fig. 2).

Usually the testing of a single area will suffice. If it is desired that additional areas be checked, the coils can be repositioned. It is even possible to set up a scanning device, with both fixed and variable coils moving automatically and simultaneously from one end of the case to the other, to check the entire length of sidewall.

The magnetic properties can be evaluated by observing the actual readings on the indicating instrument. The more positive readings indicate a more magnetic material, the more negative readings less magnetic. If a reading falls out of normal range, or if it falls completely off the indicating scale, the specimen being tested can be considered physically or chemically different from the other test pieces. An off-analysis steel, a faulty dimen-

sion, or some other serious defect may be indicated.

Many variables can affect the magnetic reading. While a magnetic test will indicate the presence or degree of a physical or chemical characteristic, it is up to us to determine what that characteristic is. Much depends on how the test is set up. All test pieces, particularly in the areas being tested, should be of essentially the same size and shape. The testing should be carried out at points in the production line that best reflect the properties with which we are concerned. In addition, the comparator should be adjusted so that existing extraneous variables, in their effect upon the magnetic readings, do not approach in importance the effect of the variable being measured.

The readings obtained represent the properties of the steel to only a certain limited depth. With magnetic equipment operating in the frequency range of ours, this depth can be varied up to a maximum of about 0.075".

Practical Application

The steel cartridge case meets all the qualifications a product should have to make magnetic testing feasible and desirable. It is made of a magnetic material which falls within a fairly well controlled range of chemistry. Because the case itself must fit into the gun tube perfectly, and must be a good fit for the projectile (inserted at one end) and the primer (inserted at the other end), dimensions are carefully checked from one operation to the next, and tolerances are small. The cases therefore do not vary much in size and shape. With such a mass production item, the testing must be rapid and inexpensive. Finally, many of the operations which a steel cartridge case undergo have an effect upon magnetic characteristics, making it possible to apply such testing at many key production points.

Magnetic comparator testing of steel cartridge cases is now being applied to great advantage at Ekco Products Company. A maximum of information and control is being obtained with a minimum of effort and cost.

Process Annealing

During cupping and deep drawing of the cartridge case, the steel is work-hardened. Each draw hardens the metal to such a degree that a softening operation is required before further work can be carried out. This softening is brought about by process annealing within the range of 1200° F to 1300° F. If any metalworking difficulties then exist, the question arises: Is it hard steel? The lubricant? The tools? The press?

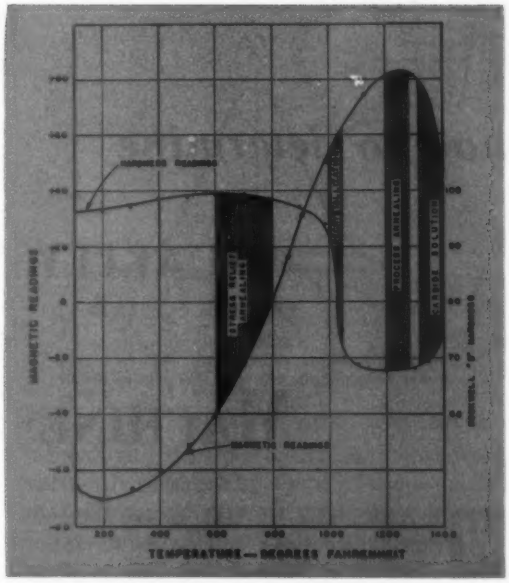


Fig. 3. Effect of varying temperatures upon the hardness and magnetic properties of cold-worked SAE-1030 steel.

The most logical thing to look for first is hard steel — pieces which may have received insufficient process annealing or have by-passed the anneal completely. The questionable lot of drawpieces can be spot-checked by hardness testing. If evidence exists of metal not fully process annealed, then all the pieces can be sorted by hardness testing.

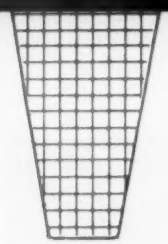
For more rapid discovery and sorting of hard metal, we have found magnetic testing to be a valuable tool. In a matter of minutes, and with great accuracy, hundreds of pieces can be checked magnetically to determine whether they have or have not been process annealed.

In Figure 3 we can observe the effect of heat upon the hardness and magnetic characteristics of the cold-worked steel. As the temperature is increased beyond 200° F, there is a marked increase in magnetic properties. This increase finally tapers off at about 1200° F, and actually reverses direction shortly beyond 1300° F. Observing the Rockwell B hardness curve, we note a slight increase up to a temperature of about 700° F, then a gradual decrease, and finally a precipitous drop at about 1100° F. This drop represents recrystallization of the cold-worked structure, and must be completed if the process annealing is to be considered effective.

It takes very little extra work to interpret the extent of the process annealing, i. e., the actual temperature reached by the test piece.

Figure 3 suggests a few other points of technical interest:

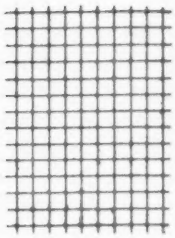
. . . *Continued on page 200*



*Part II of Two Parts**

how to determine

QUALITY CAPABILITY OF MACHINES AND TOOLS



WE ARE NOW READY to use the information we have calculated to date to show what the machine can do if it is properly controlled. This is what is called the Quality Capability of the machine.

In order to do this we return to our calculation of Datum Dimension A Spindle No. 1. If you will recall

$$6\sigma = 3.12$$

If we can learn to center this spindle at 2.5, our specification mean, we can have the condition as illustrated in Figure 11.

This is calculated as follows:

$$\bar{\bar{X}}' = \text{Desired average}$$
$$3\ \sigma = 1.56\ (3 \times .52)$$
$$\bar{\bar{X}}' + 3\ \sigma = 2.5 + 1.56 = 4.06$$
$$\bar{\bar{X}}' - 3\ \sigma = 2.5 - 1.56 = .94$$

According to this, our total variation expected would be from .94 to 4.06. In calculations similar to those for Table IV, we would expect an insignificant amount (less than .00003%) to be out of specification. In turn we can also expect a similarly insignificant amount of out of specification parts for all spindles and for both dimensions if we centered all spindles.

To summarize we would state that the quality capability of the machine is approximately 3.5 thousandths (the 6 σ for the worst spindle). We would also state that the machine is capable of maintaining this dimension between 0.75 and 4.25 (using the largest 6 σ of 3.5 and a center of 2.5). Finally, if quality controls are established, out of specification parts on this dimension should be at an absolute minimum (less than .001%).

by Harmon S. Bayer
HARMON S. BAYER & ASSOCIATES
Quality Control Consultants
Detroit, Michigan

The Facts on the Case

Now, the proof of the pudding is in the eating. Up to now we have been talking about theory. We have said what could happen if controls were established. Let us refer to the actual events that occurred on this machine.

Using the $\bar{X}$ and R Chart To Attain and Maintain Control

In order to show this we would like to point to Figure 12, which is a record of the results of what happened when we placed an $\bar{X}$ and R chart reflecting Datum Dimensions A and B for Spindle No. 1. Of course, similar charts were placed on the machine covering all the other spindles. With the cooperation of the foreman, job-setter and operator, we followed the $\bar{X}$ and R charts and made adjustments according to what was shown on these charts.

When the charts were established on the machine, five consecutive pieces were obtained from each spindle and recorded similar to that shown in Figure 2. Data were then taken periodically to reflect the changes that were made and to give us logical decisions for future changes.

Calculations for $\bar{X}$ and R Chart Limits

First let us cover the method of calculating the control limits for the chart.

The Range Chart

If you will remember, our upper control limit for the Range chart on Datum Dimension A Spindle No. 1 was calculated as follows:

* PART I, TOOLING & PRODUCTION, May 1954. See also, Editor's Note, page 214 this issue.

$$UCL_R = D_4\bar{R} = 2.11 \times 1.2 = 2.54$$

Now the lower control limit for the R Chart (LCL_R) is

$$LCL_R = D_3\bar{R} = 0 \text{ (see references cited)}$$

The $\bar{X}$ Chart

The limits of the $\bar{X}$ chart are obtained as follows:

Upper control limit for $\bar{X}$ ($UCL\bar{X}$)

$$UCL\bar{X} = \bar{\bar{X}}' + A_2\bar{R}$$

In this case we desire to control to an average ($\bar{\bar{X}}'$) of 2.5, our specification mean, so

$\bar{\bar{X}}' = 2.5$

$\bar{R} = 1.2$

$A_2 = .58$ (a constant in the references cited)

$$UCL\bar{X} = \bar{\bar{X}}' + A_2\bar{R}$$
$$= 2.5 + (.58 \times 1.2)$$
$$= 2.5 + .7 = 3.2$$

Similarly, for calculation of the lower control limit:

$$LCL\bar{X} = \bar{\bar{X}}' - A_2\bar{R}$$
$$= 2.5 - .7 = 1.8$$

Discovering a Tooling Fault Using the $\bar{X}$ and R Chart

Calculations for Datum Dimension B revealed a capability almost identical with Datum Dimension A on individual spindles which was logical since the same tool cut both dimensions simultaneously. It was decided to plot both dimensions on the same $\bar{X}$ and R Chart for each spindle.

Please refer to Figure 12 during the following discussion.

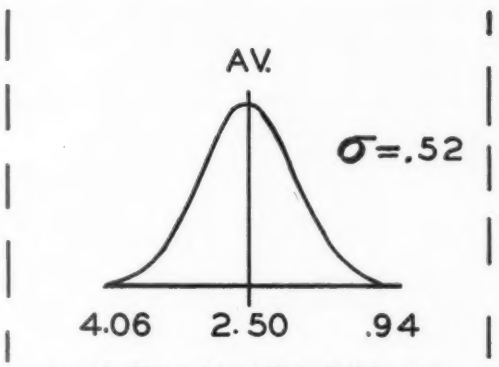


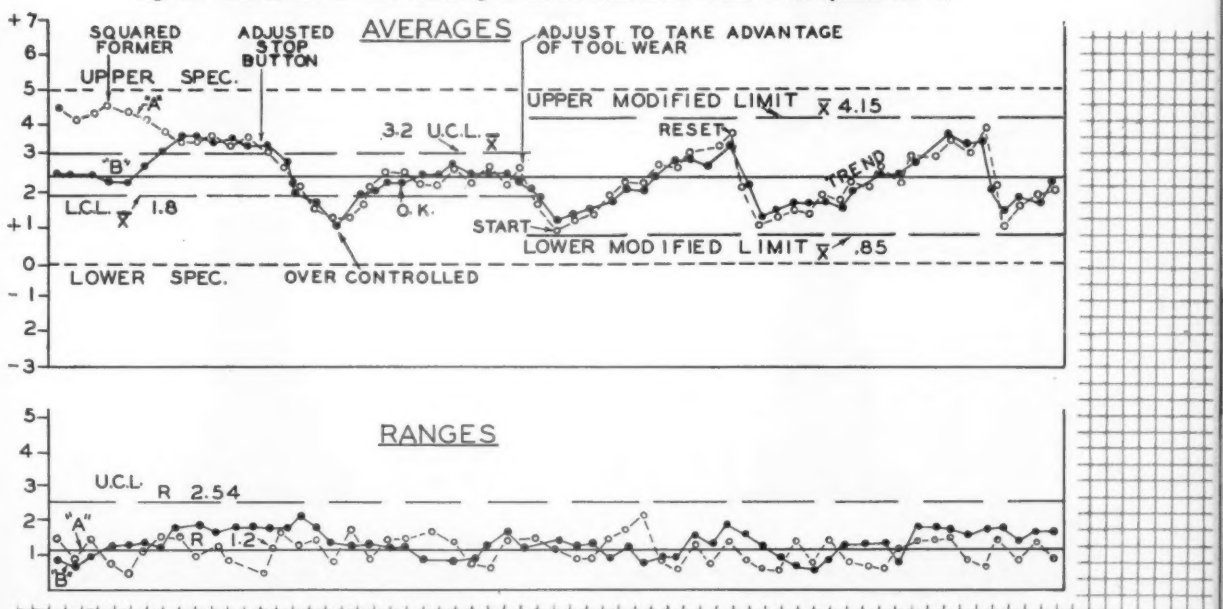
Fig. 11. This is the result obtained by centering spindle No. 1 at the specification mean of 2.5.

The first thing that was noted was that the $\bar{X}$'s for A and B as plotted on the chart were consistently different by about 1.5 thousandths. This consistent difference was also found on every spindle. We reasoned that since the dimension was cut simultaneously, the form tool was out of square by about 0.75 thousandths. We pointed this out to the job-setter who squared his tool. Dimensions A and B now showed the properly related averages.

Adjusting Spindles to Center

We then pointed out that the average reading was about one thousandth too high as indicated on the points that were plotted on the $\bar{X}$ Chart. The stop for this spindle was then adjusted and we note that there was an overcompensation of about 1.25 thousandths on the low side, Figure 12. The job-setter then adjusted upward and succeeded in centering this spindle.

Fig. 12. The $\bar{X}$ and R chart recording of Datum Dimensions A and B for spindle No. 1.



We then turned our attention to each of the other spindles. It was found that some spindles were high while others were low. Over a period of about three hours by constantly checking with the charts, we were able to adjust each of the stops for the spindles and fairly well centered all spindles. Note that during this time the $\bar{X}$ points plotted for Spindle No. 1 remained within our control limits. As time went on we were able to maintain a well controlled process for this machine and all spindles showed controlled variation with $\bar{X}$ points within the control limits.

Control Achieved

Our 100% inspection checkers further corroborated the controls shown on the charts. Figures 13 and 14 indicate what was found by these 100% checkers during this control period. Note that both of these dimensions show very little variation in the average of each of the spindles. The overall average for both is approximately 2.5 while the dimensions for both vary from about .6 to 4.5.

This confirms conclusively that the variation that had been predicted could be obtained with Quality Control procedures. The slightly wider distributions shown for these spindles exceed the calculated figures, but this was due to our inability to exactly center each spindle to within a few tenths of a thousandth. Also tool wear contributes to this slightly wider distribution.

Training

The charts were left at the job and all shifts were trained in the procedures for plotting the

. . . *Continued on page 206*

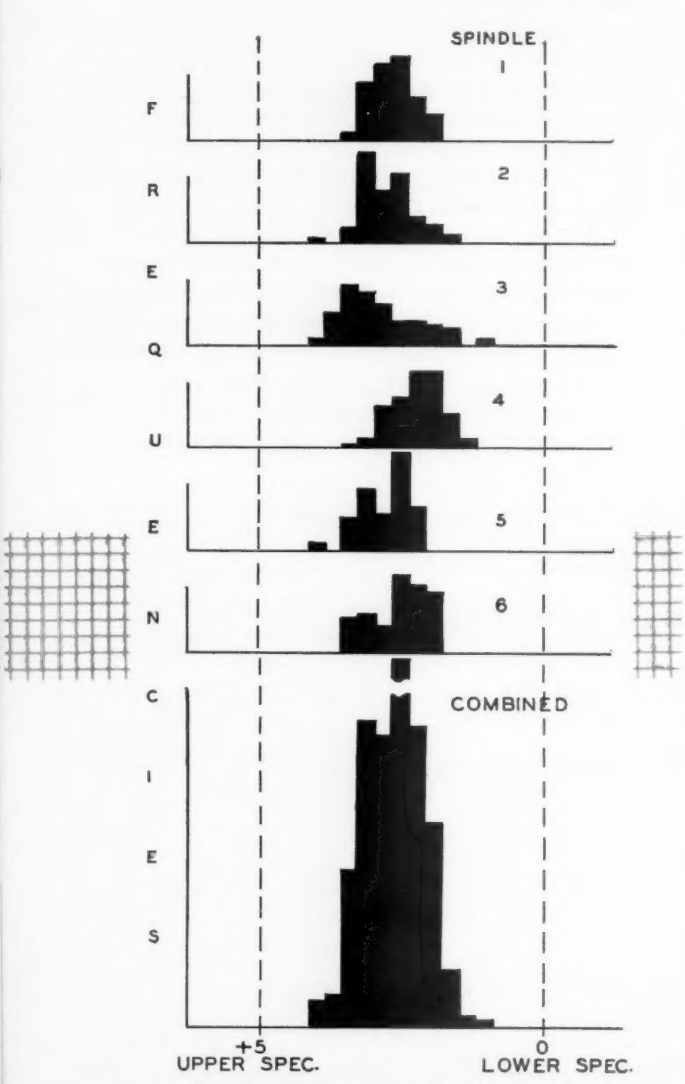


Fig. 13. Datum Dimension A for the six spindles after study and corrective action.

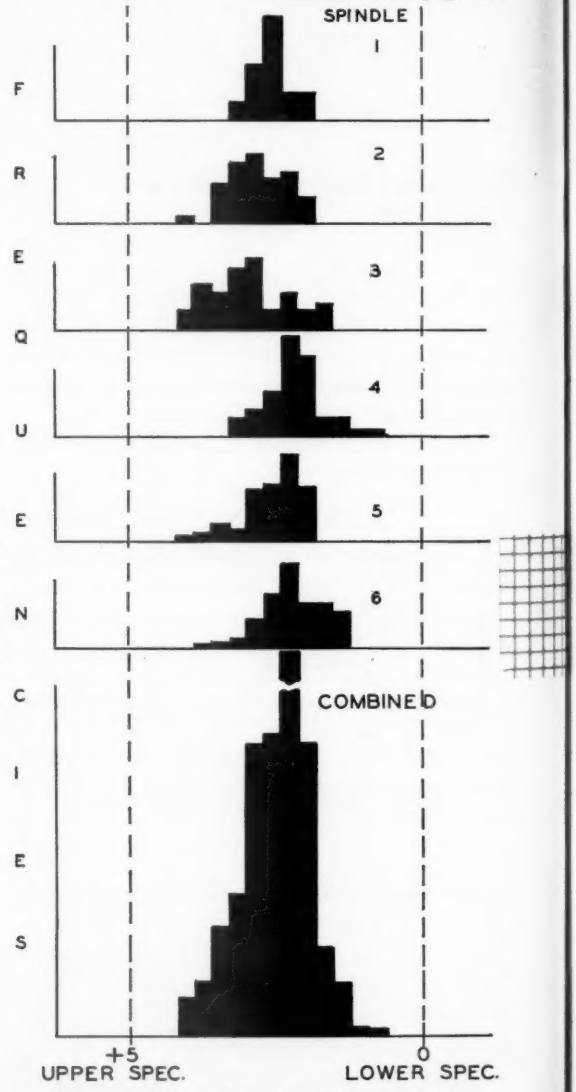
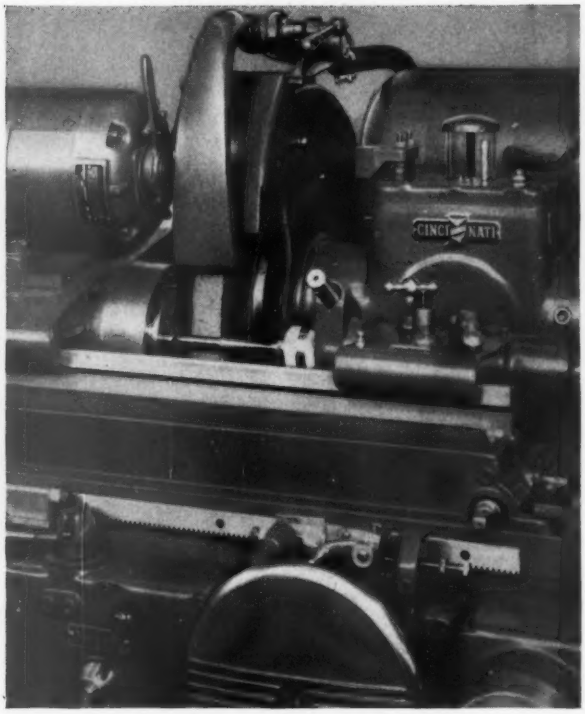


Fig. 14. Datum Dimension B for the six spindles after study and corrective action.

Grinding the sleeve diameter of a gear assembly. CINCINNATI FILMATIC 10" Plain Hydraulic Grinder.



Infeed grinding the bearing diameter of a cotton picker spindle, CINCINNATI FILMATIC 6" Plain Hydraulic Grinder.

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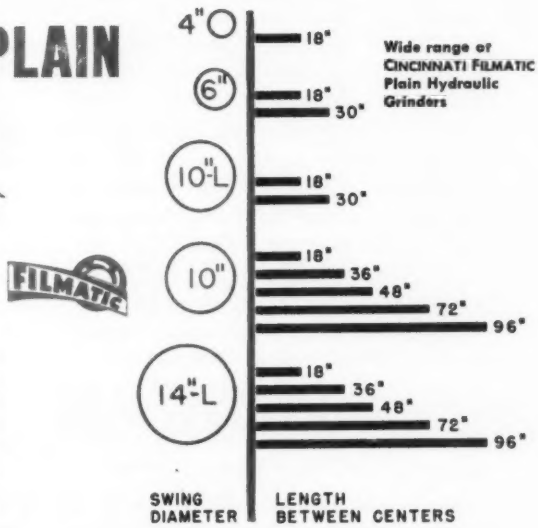

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CIRCLE INFORM-A-GRAM KEY NO. 891

WHY DOESN'T THE STEEL INDUSTRY USE QUALITY CONTROL?

THROUGHOUT THE PAST TEN YEARS, during which period statistical quality control methods have been increasingly popularized throughout American industry in general, rather widespread surprise has been expressed because these concepts have not been more widely accepted and utilized by the basic steel producing industry. The causes for such expressions are believed to be several.

First of all, the steel industry historically has been organized to use numerous statistical techniques in process and product analysis, although this may not have been apparent to the average observer. As a matter of record, the first formal organization of a "society" composed of individuals dedicated to the problems of applying the techniques of statistics to industrial problems was April 19, 1941. A large majority of the founding members were from the steel industry and the founding grew out of a meeting of six men in October of 1938, all associated with that industry.

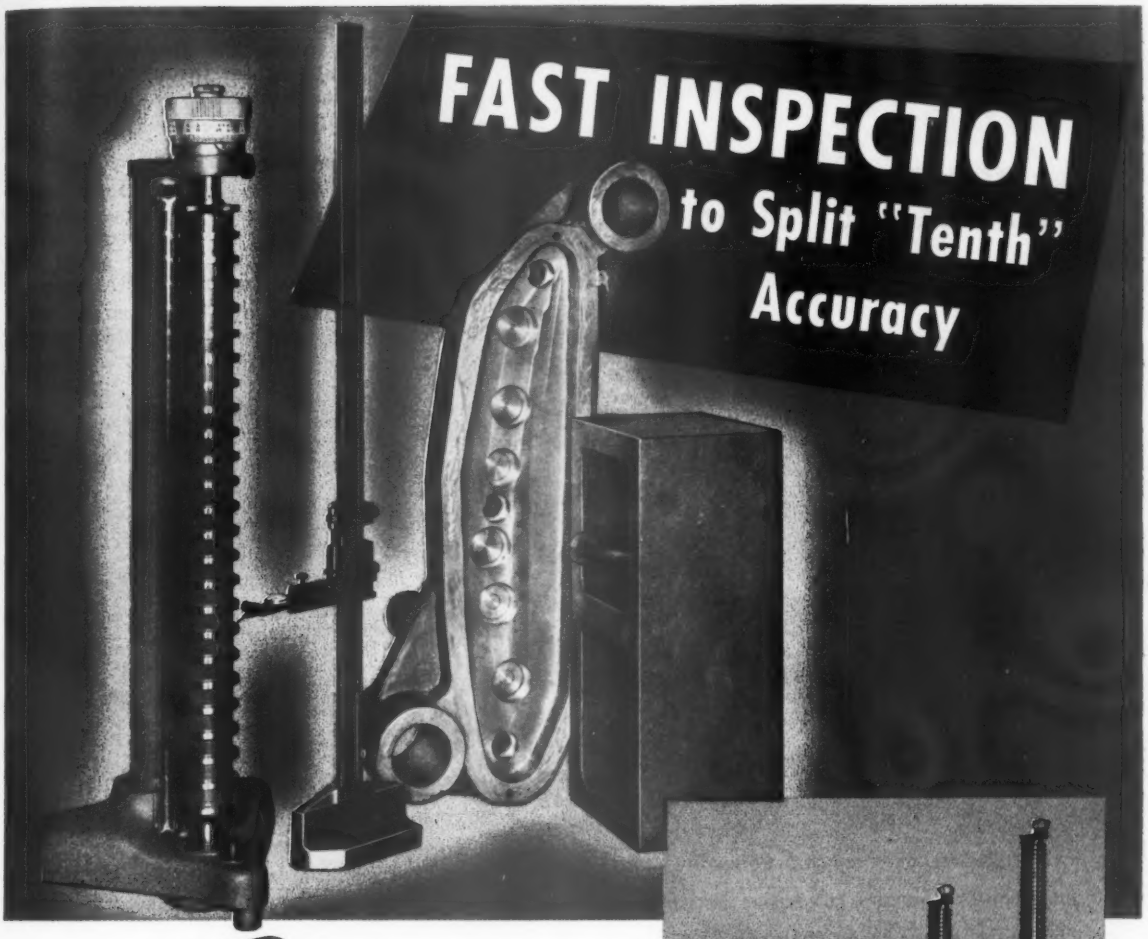
One would naturally think that in the light of these conditions the utilization of the more modern concepts such as the control chart, inspection sampling, variance analysis, correlation, and the like would have found rapid and enthusiastic acceptance. Such thinking would ignore an established heritage, for this industry perhaps more than any other has been steeped in tradition. It has appeared to be abnormally resistant to change, but from long experience it has found the old adage "make haste slowly" to be a sound one.

Second, the very nature and great complexity of the steel making process and its technological control did not attract as high a percentage of individuals with mathematical and statistical training as did some other industries. The heavy end of process control lay in the hands of the metallurgical groups, and in recent years the metallurgists have been hard pressed to keep pace with the rapidly developing metallurgical phases of the industry and have found little time to advance their knowledge of statistics. Because the industry felt it advisable to train individuals with a broad knowledge of steel plant operations to apply statistical procedures to current problems, rather than to try to teach the steel business to an individual well grounded in statistics, the training of competent and qualified personnel has been a problem of considerable magnitude.

Third, since the bulk of the early quality control experiences, literature, case histories, etc., had developed around the repetitive-

. . . Continued on page 95

by Wade R. Weaver, Director
Steel Conservation & Quality Control
REPUBLIC STEEL CORPORATION
Cleveland, Ohio



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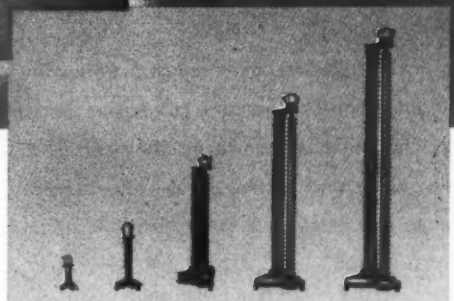

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CIRCLE INFORM-A-GRAM KEY NO. 921

. . . Month's Talk, from page 42

graphing the interpretation of these senses through to the machine primarily by the use of hands.

Operator Aids Built In

We have seen machine design grow with a continuous effort to provide mechanisms which would minimize the effort and the responsibility of the man.

Many of these designs were not particularly directed towards the transfer of skill of the operator but primarily to help the operator conserve strength, reduce fatigue, and also place at his convenience refinements for control.

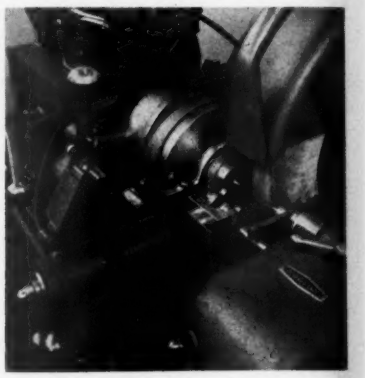

Fig. 1. Work-loading mechanism and cycle-operating control on 10" semi-automatic machine for grinding valve plugs.

Hydraulic footstocks, power wheel head traverse, automatic coolant shut-off, grinding gages, selectable feed controls, booster features for mass movements, vee work supports, hydraulic automatic steadyrests, and built-in truing devices are examples of these design results.

The challenge of the future will be to take the most difficult of the human attributes of skill, and mold them into machine design. The simpler problems already have been absorbed. This progressive transfer of operator skill to the machine is fundamentally what is involved in the design problems of the present.

What Is Involved

As we move into the engineering of our cylindrical grinding machine to make it fully operative without the human, we struggle with detailed problems which give us opportunity for humble recognition of ourselves as humans. We sometimes reflect and think of how the Lord

. . . *Continued on page 96*

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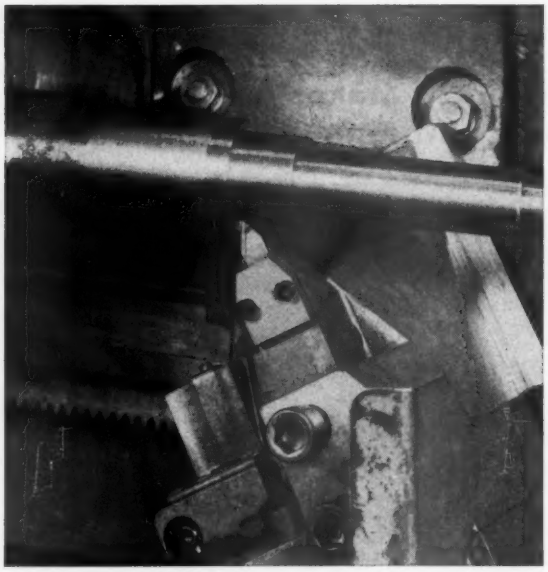
CIRCLE INFORM-A-GRAM KEY NO. 931

...a performance report on another Kennametal grade with ideas you can use to cut machining costs



New Kennametal profiling tool, with clamped K4H grade insert, machining pinion gear blank on New Britain + GF + Copying Lathe. The Lathe's hydraulic system operates the copying slide and actuates several automatic functions.

100% increase in surface speed on New Britain +GF+ Copying Lathe with new Kennametal* K4H Profiling Tool

A series of tests were run to determine which tooling would best utilize the performance potential of this New Britain +GF+ Copying Lathe in profiling SAE 8720 steel pinion gear blanks.

With K4H inserts clamped in new Kennametal PT Style Tools, these tough pinion forgings were profiled at 850 RPM. The machining time averaged 32 seconds, holding plus or minus 0.001 inch on all diameters. The depth of cut on each side was 3/8 inch. An average of 220 pieces were machined per grind.

Prior to testing K4H inserts, the maximum lathe speed practical with standard brazed carbide tools was 425 RPM.

The 100 percent increase in surface speed made possible by the use of K4H inserts permitted fuller utilization of the capabilities of this new, versatile, high speed lathe. A20

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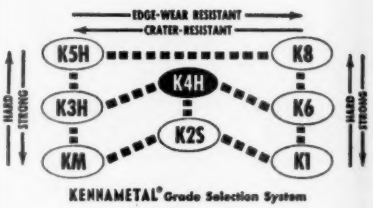
K4H is a hard grade with unusually high strength which makes it suitable for roughing scaly, abrasive steel castings and forgings where both edge-wear and crater resistance are required. Versatile K4H is also an excellent grade for interrupted cutting and, when used as a brazed tool, for a variety of finishing operations where the chip load is light.



KENNAMETAL® Grade Selection System

The easy-to-use grade selection guide shows that K4H is harder than K2S—more crater resistant than K6—more edge-wear resistant than K3H. It is an intermediate grade having a wide range of application. Where greater edge-wear or crater resistance is desired, performance can be improved simply by changing to the grade indicated on the guide.

Across the country, over 150 Kennametal Tool Engineers are helping plants solve their machining problems by analyzing tool wear—helping select the tool or grade best suited for the job—conducting in-plant training programs. You'll find Kennametal Offices listed in the classified sections of telephone directories in principal cities. Call your nearest Kennametal Tool Engineer, or write to KENNAMETAL INC., Latrobe, Pa.

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CIRCLE INFORM-A-GRAM KEY NO. 941

. . . Steel Industry, from page 90

ly produced type of products such as machined parts, small components, ammunition, and the like, considerable difficulty was experienced by the early advocates of quality control in the steel industry in usefully applying the principles which had proven so effective in other industries.

It was unfortunately true, and still is among an extraordinarily high percentage of people acquainted with modern quality control, and even among many of its addicts, that this new management tool was considered an "inspection tool." Not that the steel industry had no inspection problems; it had plenty of them. But the sampling inspection techniques which worked so nicely in an automatic screw-machine shop did not make manifest their ready application to steel plant inspection.

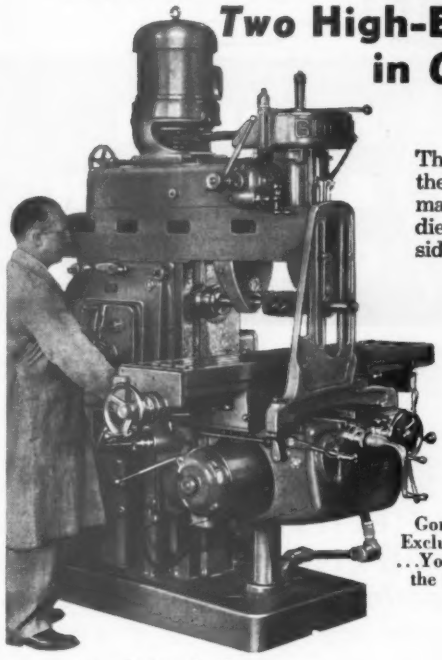
Product flow and the very buildings which housed it often made standard sampling inspection procedures seem insurmountable in application. Defective product did not appear to conform to the laws of chance and probability, being definitely non-randomly distributed, and measurements seemingly required for quality control analysis proved inaccessible. The magnitude of batches of material being handled at high temperatures posed many problems. To apply advocated inspection methods to qualify a lot of material, to determine its quality level, would frequently result in holding up not only several carloads of material, but at times even entire trainloads. This proved incompatible with plant layouts, warehousing and handling facilities, as well as necessary product flow.

In short, applying the recognized and proved techniques of quality control to the production of steel presented a brand new series of problems in the field. Progress was slow, painfully so at times, but it was positive and sound. During the past two years it has proceeded at a vastly accelerated rate and it can be truly stated that the industry appears to be on the brink of cashing in on its applied imagination, determination, and education.

To the American Society for Quality Control's Metals Techni-

. . . Continued on page 98

New Gorton 2-28 Brings You *Two* High-Efficiency Mills in *One* Money-Saving Unit



. . . as a horizontal mill.

The Gorton Receptor Ram makes the new 2-28 a true multi-purpose machine . . . "tailor-made" for *all* die-mold-machine shops. Consider the facts:

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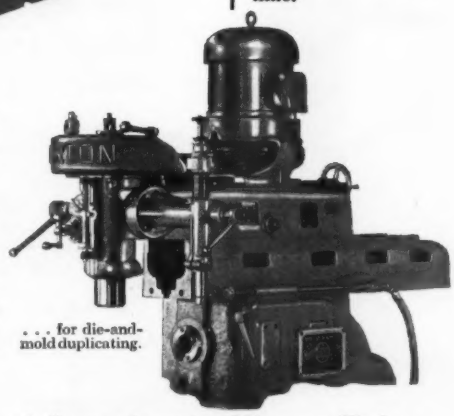
HORIZONTAL MILL

VERTICAL MILL (Super-speed)

DUPLICATOR (Simply add a duplicator head and a duplicator table.)

NOTE: You can switch from horizontal to vertical high-speed milling in 5 minutes or less. Save space and capital equipment — and increase production facilities at the same time.



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- Fullwidth knee, 24½ inches wide, provides extreme rigidity. Even under heavy cutting loads, there's no sag or twist.
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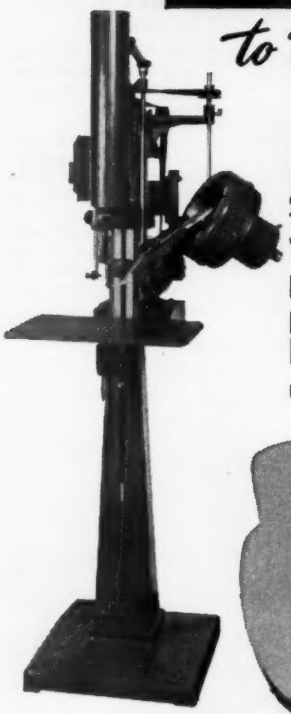

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CIRCLE INFORM-A-GRAM KEY NO. 961

. . . Month's Talk, from page 92

must be smiling at us to see what a mess we make of these engineering problems when we ourselves are such a wonderful perfectly engineered composition of matter, motion, power and control.

Consider a conventional precision cylindrical grinder and observe what the machine does and what the operator as a human contributes. He places the

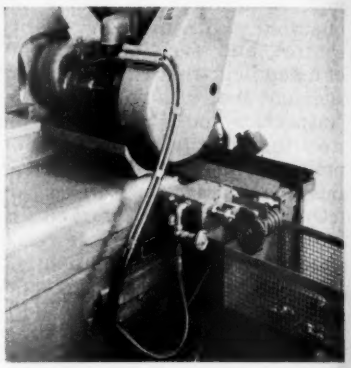

Fig. 2. Work-conveyor arrangement on machine shown in Figure 1.

work between centers and initiates the use of the power within the machine to rotate this work, traverses his wheel to remove the desired stock under conditions which the material and the machine will accept. He controls the size and the finish, readily making adjustments for the many variables involved when grinding. As he progresses he arrives at decisions by seeing and hearing, which results in such elements as size control, finish, wheel-wear adjustment, wheel-dressing, and compensates at his will to remedy or correct.

Mechanical Problems

If our design attempts to do these same things by removal of the services of man, we are faced with many difficult mechanical problems to solve. It is not too difficult to place work in and out of a machine; but, the masses and motions, as well as powers to accomplish such an operating mechanism, create considerable limitations on such elements as physical space, acceleration, deceleration, smoothness of operation, reliability of operation with minimum of wear and servicing.

Rotating turrets, chain conveyors, vibrating bowls and tracks, positive action gripping

. . . Continued on page 100

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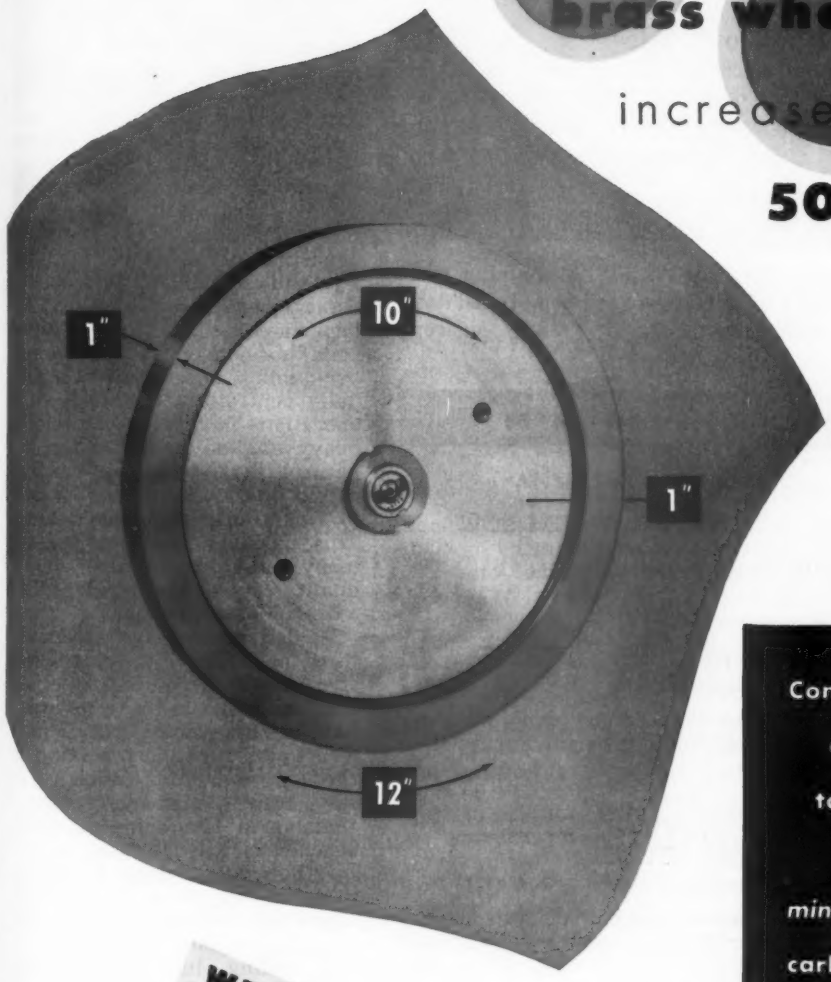

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. . . Steel Industry, from page 95

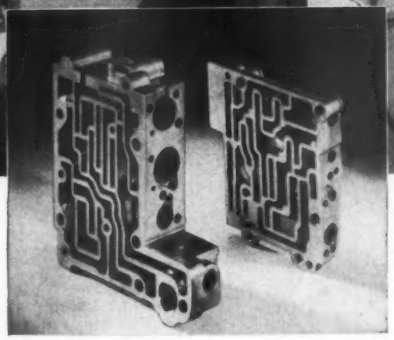
cal Committee goes much of the credit for sparking coordinated programs leading to a better understanding of mutual problems. The astonishing growth of that Society (current membership is over 8,500) is reflected in the activities of its many committees and divisions, of which the Metals Technical is one of the most active. Through broadly conducted surveys, the sponsoring of technical presentations at the Society's national conventions and other allied activities, the committee has already proven of great value to the steel industry, among others.

Today most steel producers have quality control departments and programs of one type or another in effect. These vary from the single individual engaged in process control or study, through groups allied with other departments, up to the fully integrated department completely on its own and reporting directly to top management. Since metallurgical departments historically have been the watchdogs of steel product quality, and where not actually controlling the inspection operations have at least held a heavy hand on them, it would be natural that quality control would find itself frequently tied to metallurgical departments. This parallels the situation in many other industries where quality control has developed as a branch of inspection.

Industry-wide surveys indicate this particular organizational structure to be quite a popular one, although some producers have set up quality control as a direct staff function reporting to the top production official. In such cases almost every operational area plus some others is reached at least to some extent by the quality control department. Investigations and controls cover raw materials, blast furnace, coke plant, melting, heating, rolling, inspection, metallurgical, finishing, safety, overtime, personnel, market research, customer relations, claims, and a lot more areas.

This would make it seem certain that quality control installations which are subservient to some other technical branch might be restrictive in their potential coverage. This will be

. . . *Continued on page 103*



Holes on extremely close centers vary in diameter from 1/16" to 13/16". The valve body has 33; the cover, 18.

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. . . Month's Talk, from page 96

fingers are representative of such designs and are illustrated in Figures 1, 2, and 3.

Size control also can be solved readily by modern design using electrical, hydraulical, or pneumatic arrangements with a high degree of amplification, telegraphing to some other control circuit the completion of the cycle of operation when the instrument and its mechanism has recognized the desired size.

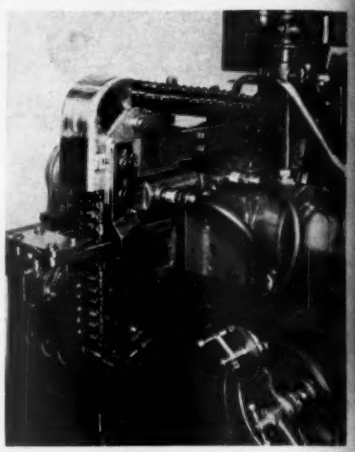

Fig. 3. Right-side view of chain-type loading fixture with work loaded in position on 10" full automatic grinding machine.

Feeding motions for the grinding wheel have developed from simple manual operations to automatic type. A modern design of feed motion is illustrated in Figures 4 and 5. Here, the positioning motions not involving accuracy are provided by a hydraulic cylinder which serves to push and pull the wheel slide through the contact of the half-nut with the feed screw. Refined motions are provided by rotation of the screw, the nut being fixed to the slide. Power for rotation is from a hydraulic cylinder imparting

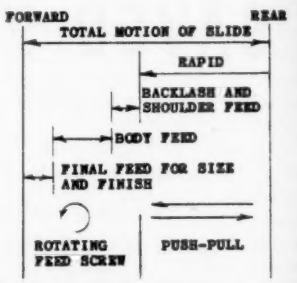

Fig. 4. Schematic diagram of grinding-wheel feed motion.

. . . Continued on page 108

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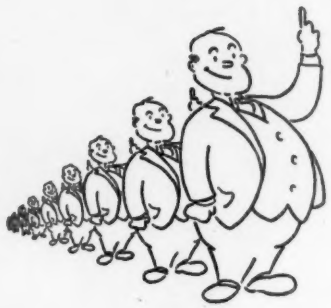

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WALKER DUPLICATORS are able to mill any shape that it is possible to get a tracer and cutter into. WALKER hydraulic Duplicators are being used to great advantage on the INDEX mill at the Quick Tool Co. in Chicago. Great accuracy and speed are being obtained on many jobs that are impossible by any other means. The Quick Tool Co. is one of Chicago's most aggressive manufacturers. They have quite a number of WALKER hydraulic Duplicators that have been installed over a long period of time. They believe in Tracer Controlled Machining!

WALKER DUPLICATORS are not placed on small mills only, as we have them on some of the largest mills built. We do not confine ourselves to building Duplicators for milling machines only, but for other machine tools as well; such as: lathes, planers, shapers, boring mills, (both horizontal and vertical) and special machines. We are the largest manufacturer of hydraulic Duplicators, a place we have held for the past 25 years.

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. . . Steel Industry, from page 98

more fully realized and appreciated with the passage of time and expansion of the areas covered by these activities is certain to result. Companies whose experience with quality control covers eight to ten years are definitely becoming aware that the potential field has hardly been tapped.

There are numerous cases of concentration on research problems, both of the pure research nature as well as process research. Despite the rapid advances made in the entire field of steel production during the past 15 years, there is still much that remains an art rather than a science. Although a great deal is known about the blast furnace, open hearth, electric furnace and bessemer operations, recent quality control investigators are amazed at how much is obviously still unknown. Immeasurable benefits lie ahead if certain perplexing problems can be solved effectively.

Such research requires individuals of unusual experience combinations, a long exposure to the operations, some of which do not repeat themselves very often, and a strange combination of imagination, determination, curiosity, and desire. Since quality control is so admirably suited to the design of experiment, researchers can no longer afford to be without its benefit. Such individuals are extremely hard to find within the steel industry and are practically impossible to find outside it. This magnifies the problem of training, always the bottleneck right from the outset.

All companies, in discussing expansion of their quality control operations, complain of the dearth of qualified people. Not qualified statisticians, but competent and experienced steel people fortified with quality control training of a practical nature. This latter adjective means actual experience, not academic exposure.

Government procurement agencies, and especially those associated with the several armed services, are pushing with increasing intensity for the inclusion of quality control sampling plans on materials inspection and release as part of the contractual obligation. Many contracts not only include such plans in the

. . . *Continued on page 106*

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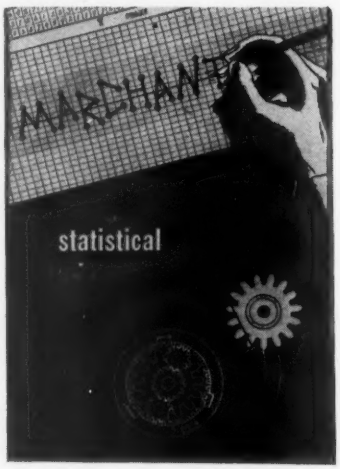
QUALITY CONTROL . . .

A comprehensive 52-page manual on statistical quality control has been published by Marchant Calculators, Inc., Oakland 8, Calif. Through ex-



tensive use of photographs, charts, graphs, and mathematical formulas, the booklet covers how Q.C. ties in with all phases of the manufacturing picture — design, planning, engineering, tooling, purchasing, production control, and inspection.
Circle Inform-A-Gram No. C1.

SHELL MOLDING . . .

An informative, illustrated manual on shell molding — demonstrating how this casting process has reduced machining and finishing costs as well as foundry casting time — has been announced by the Chemical Materials Department of General Electric Co., Pittsfield, Mass. The 28-page brochure (CDC-272) describes the latest developments in shell molding, and the benefits offered by this process. The latest information on resins and new foundry techniques in this growing industrial field are contained in the practical handbook. Shell molding, itself, is a new foundry process designed to make thin sand molds for the production of smooth, accurate castings. Case histories, testing methods and production techniques are comprehensively treated in the publication.
Circle Inform-A-Gram No. C2

FIRE SURVEY . . .

A 57-page survey on fire hazards and safeguards for the metalworking industry has been published by the National Board of Fire Underwriters, 85 John St., New York 38, N. Y. The booklet contains statistics on fire losses in both light and heavy metalworking plants since 1942 and points out old fire causes.
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ANCHORING DATA . . .

A new illustrated technical bulletin entitled "Anchoring Bearings, Bushings, & Non-Moving Parts in Machinery" has been released by the Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y. This bulletin contains valuable information on the subject mentioned in the title. It describes methods that have resulted in substantial savings in time and labor for many firms.
Circle Inform-A-Gram No. C4.

SCREW THREADS . . .

A regular encyclopedia of screw thread information is the new 52-page manual now available from the Greenfield Tap and Die Corp., Greenfield, Mass. The booklet contains such helpful data as constants for finding screw thread elements; the basic point in thread measurement; the unified thread system; screw thread tolerances; and limits for threaded products. All the subjects discussed are accompanied by diagrams, charts and drawings. Also, major specifications and dimensions are included in the publication.
Circle Inform-A-Gram No. C5.

CONVERSION GUIDE . . .

A handy wall chart showing the new designation system for wrought aluminum and wrought aluminum alloys has been prepared by Kaiser Aluminum & Chemical Sales, Inc., Industrial Service Division, 1924 Broadway, Oakland 12, Calif. The conversion guide indicates old and new designations in easy-to-read bold type. It may be used either as a wall chart, or punched and inserted in a three-ring binder. The new four-digit system developed by the Aluminum Association became effective the first of this month.
Circle Inform-A-Gram No. C6.

STOCK SIZE CHART . . .

A large wall chart showing stock sizes of Uddeholm flat ground tool steels and drill rods is available from Uddeholm Company of America, Inc., 155 E. 44th St., New York 17, N. Y.
Circle Inform-A-Gram No. C7.

RUST CHART . . .

A new rust preventive chart (No. 954) is now available from the Nox-Rust Chemical Corp., 333 N. Michigan Ave., Chicago 1, Ill. Listed on the chart are those packaging and preservation materials which the company produces in conformance with various military specifications. Also included are detailed properties of a number of products of interest to firms doing industrial or military contract rustproofing operations.
Circle Inform-A-Gram No. C8.

"LOST WAX" GUIDE . . .

This pocket-sized booklet is written as a guide to metal working executives and design engineers who wish to build a file on both the benefits and limitations of the "lost wax" investment casting process. Besides a description of the process, this newly-published brochure also dis-

cusses in detail many basic design principles as they apply to the investment casting processes. A materials chart listing physical properties and use of some of the more popular metals is also included. To obtain your copy of this booklet write to Midwest Precision Casting Co., Dept. TP, 2790 Grand Ave., Cleveland 4, Ohio, or—
Circle Inform-A-Gram No. C9

TOOLING and PRODUCTION'S Inform-A-Gram Section is a CARDload of Information

CAM MILLING . . .

This booklet is designed to acquaint the mechanic with the various methods and attachments that may be used in milling cams. Written in non-technical language and illustrated with numerous operational photographs and sketches, it will prove helpful in providing the basic information in the setup and machining of cams. The booklet is available from the Kearney & Trecker Corp., Milwaukee 14, Wis.

Circle Inform-A-Gram No. C10.

HACK SAWS . . .

Suggestions on how to use and maintain hand and power hack saws are contained in a booklet available from The Simonds Saw and Steel Co., Fitchburg, Mass. Included in the publication are specifications on both tungsten high speed power blades and "weld-edge" shatterproof power blades.

Circle Inform-A-Gram No. C11.

SHOCK & VIBRATION . . .

Devoted exclusively to shock, vibration, and noise isolation is a new periodical published by the Barry Corp., Watertown, Mass. Called "Shock and Vibration Control Notes," this new technical house organ, published quarterly, is intended to provide a medium for the collection and propagation of ideas and information in the shock and vibration fields. For information on how to receive this publication, write to the Barry Corp., or—

Circle Inform-A-Gram No. C12.

LIFT TRUCK KIT . . .

A method for predetermining the time necessary for fork lift trucks to perform specific operations has been provided in a work kit which will enable plants to apply fork lift truck standard performance data. Included in the kits, which are available from The Yale & Towne Mfg. Co., 11,000 Roosevelt Blvd., Philadelphia 15, Pa., are typical materials handling examples to demonstrate the standard technique for application of the data as well as charts that provide times for the basic truck motion elements. Also included in each kit are a quantity of work sheets which can be used in the evaluation of standard performance times for specific fork truck operations.

Circle Inform-A-Gram No. C13.

CONVERSION CHART . . .

A chart giving comparative catalog numbers of over 100 items is available from the Northwestern Tool & Engineering Co., 116 Hollier Ave., Dayton 3, Ohio. Among the items listed are quarter turn screws; shoulder screws; knurled head screws; latch bolts; fixture keys; spherical washers; National Course, National Fine, and spherical flanged nuts, tee nuts, coupling nuts; hand knobs, plain, tapped and reamed; flat washers; jig feet and rest buttons.

Circle Inform-A-Gram No. C14.

WELDOR'S GUIDE . . .

A comprehensive and analytical study of hard facing, its application and its wear-resisting qualities wherever impact and abrasive conditions exist, is contained in a new 72-page pocket size brochure just off the press. Published by the Mir-O-Col Alloy Co., 312 North Ave. 21, Los Angeles 31, Calif., this publication incorporates the latest data and instructions on hard-facing, as well as information concerning Mir-O-Col's own line of hard-facing metals. A special section of the report, the application index, recommends specific hard-facing rods for over 1,000 individual pieces of equipment subject to impact and abrasion.

Circle Inform-A-Gram No. C15.

SAFE FEEDS . . .

A helpful chart giving safe feeds for high speed drills includes drill diameters and safe feeds for cast iron, bronze or brass, drop forgings annealed, drop forgings heat treated, steel castings, and mild steel. The chart is available from Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.

Circle Inform-A-Gram No. C16.

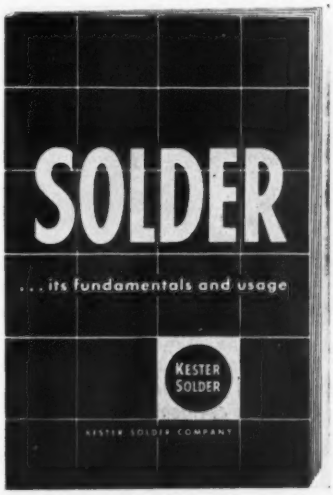
STRIP CALCULATOR . . .

A new and unique stainless steel calculator for finding weights is being offered by Ulbrich Stainless Steels, Wallingford, Conn. The calculator works on the slide rule principle, but is simple to operate. It is designed to save time and trouble for ordering stainless steel strip.

Circle Inform-A-Gram No. C17.

SOLDER TEXTBOOK . . .

Just off the press is his authoritative 80-page treatise on the subject of solder. The purpose of this book is to rectify the basic literature inadequacies on solder and to provide the solder user with a thoroughly scientific study of the industrial application and usage. Charts, tables and photographs are included in this booklet which is available from the Kester Solder Co., Dept. TP, 4201 Wrightwood Ave., Chicago 39, Ill.

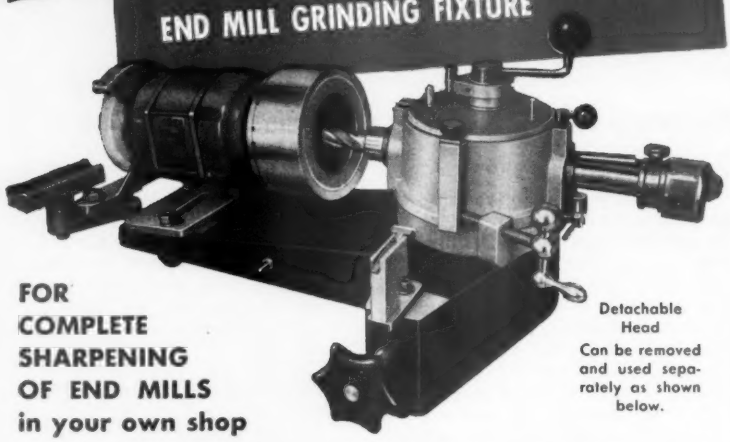


Circle Inform-A-Gram No. C18.

NEW

MULTI-SPIRAL

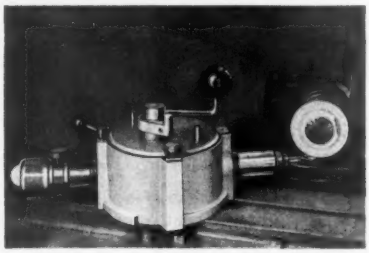
END MILL GRINDING FIXTURE



FOR COMPLETE SHARPENING OF END MILLS in your own shop

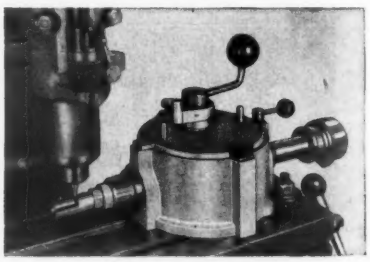
Detachable Head
Can be removed and used separately as shown below.

This revolutionary new self-contained Multi-Spiral grinding fixture makes it easy to sharpen end mills COMPLETELY, in your own shop. It eliminates sending end mills out to be sharpened, saves time, saves money. Simple to operate.



Use It With Cutter-Grinders

Photo shows Multi-Spiral Head used separately on a cutter-grinder for long web thinning, flute grinding, step grinding tools, etc.



Use It With Milling Machines

The Multi-Spiral Head can also be used separately on milling machines for milling any spiral, right or left hand.

—Additional Features

- Do "Radial-Relief" by grinding inside the wheel.
- Finish-grind spiral lips and end in one operation.
- Left hand end mills ground as easily as right hand.
- End mill can be ground with slight taper, to mill parallel slot.
- One million different leads, right and left hand.
- Reversing motor for left hand end mills. Eliminates throwing burr on cutting edge.
- Hardened spindle and hardened bearing bushings.
- Spindle has 1" hole. Set of bushings for end mill shanks, and special spindle for 5C Harding Collets are available.
- Size: 31" long, 18" wide, 16" high. Weighs only 85 lbs.
- One socket wrench fits all bushings and spindle screws.
- (Safety) grinding wheel is held inside aluminum drum.

Send For Complete Details Now!

SPIRAL STEP TOOL COMPANY

Designers and Manufacturers of All Types of Special Cutting Tools

5400 N. Damen Avenue • Chicago 25, Illinois
Phone: LOngbeach 1-5384

CIRCLE INFORM-A-GRAM KEY NO. 1061

. . . Steel Industry, from page 103

prime contract but impose upon the prime contractor the obligation to see that they are similarly applied to any sub-contractors.

Despite a written opinion by the officer then in charge of quality control activities at Wright-Patterson Air Force Base, Dayton, Ohio, to the effect that it was not contemplated that the requirements of specification MIL-Q-5923-A should be applicable to wrought steel products, requests for quotations on orders so specifying are today being received with increasing frequency. Waivers of this requirement almost invariably result upon request.

Most producers of steel products find it necessary to refrain from accepting orders specifying material acceptance under sampling inspection in accordance with MIL-STD-105-A. The applicability or inapplicability of such plans to most steel products, and especially to those products which represent the so-called continuously extended method of production, is a subject under current debate in many areas. Various groups are surveying and analyzing the attendant problems and, while it may be assumed that practical solutions will be found, it is certain that they will be slow in materializing.

Very few producers have organizations sufficiently trained to administer and implement these plans. This means more education. Practically no companies have the handling facilities and certainly not the space that is presently understood to be required. Certain specific processes would lend themselves nicely to the use of such principles for control purposes. Most of them would not; again, at the present level of understanding. This is one of the most critical problems with which the industry has to cope, since the increasing use of quality control techniques by its customers is certain to have great impact upon the steel producing industry. It is hoped that these customers will recognize the difficulties involved and appreciate that sincere efforts are being made to solve them.

In an effort to provide a valuable service to the problems of extending the knowledge of use-

. . . Continued on page 110

DIE DESIGNING AND ESTIMATING

Fourth Edition

New, completely revised

IS NOW IN PRODUCTION!

Greatly enlarged, this new Fourth Edition is destined to continue as an invaluable die engineering tool — encyclopedic in scope, authentic in source material, and thoroughly proved as a most practical shop text and teaching aid.

Based on the works "Die Designing" by Charles Bohmer and "Die Estimating" by George Dannes, DIE DESIGNING AND ESTIMATING has been widely used for many years in schools and apprentice programs, for both classroom and on-the-job training, and by die makers and die engineers as an authentic reference and refresher.

In this new edition are:

1. Greatly expanded chapters on blanking, piercing, combination, bending and forming, drawing, and progressive dies.
2. Additional material on temporary and short-run dies and selection of die materials.
3. New pages on job planning, stock layout and press tonnage determinations.

The new DIE DESIGNING AND ESTIMATING will be profusely illustrated and will contain many charts and graphs.

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Use coupon for ordering.

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Save time in gaging large dimensions with this new Ellstrom "Build-Up" Set!

What a time-saver this Ellstrom "Build-Up" Set is when it comes to checking large dimensions to millionths of an inch accuracy! And versatile, too. Six round gage blocks in step series from one to six inches, plus a standard base one-inch high. To use, just select the right combination of blocks and wring them together on the 4" diameter base. Then add standard square or rectangular gage blocks to establish the exact decimal dimensions desired! It's quick, easy, accurate . . . with far less chance of error, and none of the normal hazards encountered in building up large combinations with regular gage blocks. Won't topple over in use . . . and if accidentally knocked over, blocks are held in rigid combination by internal locking screws. Ideal for surface plate checking, setting visual gages or amplifiers, as well as for checking work on planers and horizontal boring mills. And each block is backed by the traditional heritage of Ellstrom . . . *measuring in millionths for three generations.*

Upon Request—New fact-filled catalog containing complete specifications and prices on the entire Ellstrom Standards line. Send for it today!

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Dearborn Gage Company, 22035 Beech Street, Dearborn, Michigan
Originators of Chromium Plated Gage Blocks

REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE UNITED STATES AND CANADA

CIRCLE INFORM-A-GRAM KEY NO. 1081

. . . Month's Talk, from page 100

through rack-and-gearing reduction the required rotating motions. The lead of the screw advances the wheel slide at rates established by the hydraulic control of the operating piston. Final

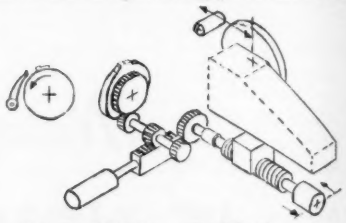

Fig. 5. Grinding-wheel feed mechanism.

size is established by the index wheel reaching a positive stop.

Control valves provide proper rate of motion and, by solenoid control, various rates may be selected and established by knife-edge orifice valves. We use knife-edge orifice valves to get results least affected by temperature changes and foreign material carried by the oil.

It has been practical to set the controls so that the final advance of the wheel slide is at such a slow rate that, though the feed never comes to a stop, an electric grinding gage can complete the grinding cycle, returning the wheel slide without a measurable spiral on stock removal of the workpiece.

Final slow-down feed allows for release of spindle oil film, deflections and other errors, giving the wheel the opportunity to develop the finish and size. Such

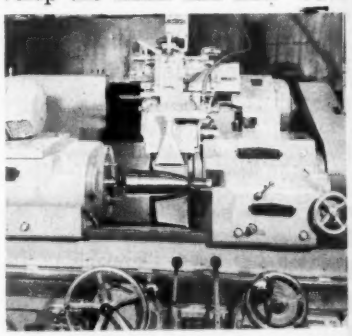

Fig. 6. Shell nose punch in semi-automatic cylindrical grinding machine.

control permits more rapid rate of stock removal when size and finish are not ready to be established.

Infeed of abrasive wheel — intermittent or continuous, or a combination type — has been a

. . . *Continued on page 112*

New facilities mean . . .

DIECO's famous die sets now available in KING-SIZE too!

As a subsidiary of E. W. Bliss Company, we are able to use their virtually unlimited machining facilities for the production of "giant" die sets.

With these facilities we can produce the largest die sets in use today.

What is more important, however, is that Dieco takes the same pains with large die sets as with the small: holes are precisely bored, pins and bushings fitted and aligned with care, plates inspected to assure perfect parallelism. In short, all the underlying design principles of our famous "finger-tip action" die sets—designs which have won unqualified approval from diemakers—are now available to users of large, special die sets.

Whatever your die set problem—large or small, standard or special—a Dieco engineer will be glad to help you. Call him into your pressroom, let him demonstrate to you why and how Dieco die sets will mount easier, last longer under even the toughest of conditions.

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PITTSBURGH, PA.	122 S. Sheridan Ave., EMerson 1-0440
DAYTON, O.	Die Supply Sales Co., 311 Vermont Ave., MI 9691
BUFFALO, N. Y.	440 Tenace Blvd., Depew, N. Y., Regent 6767-8
ST. LOUIS, MO.	Scott Special Tools, Inc., 1252 N. Kingshighway, FOrest 3454
BIRMINGHAM, ALA.	Production Tooling Service, 422 N. 24th St., 4-9081
CHARLOTTE, N. C.	Apex Machine Tool Supply, Inc., 3107 Wilkinson Blvd., FR 6-6521
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McCROSKY

1904-1954 COST CUTTING TOOLS 50TH ANNIVERSARY

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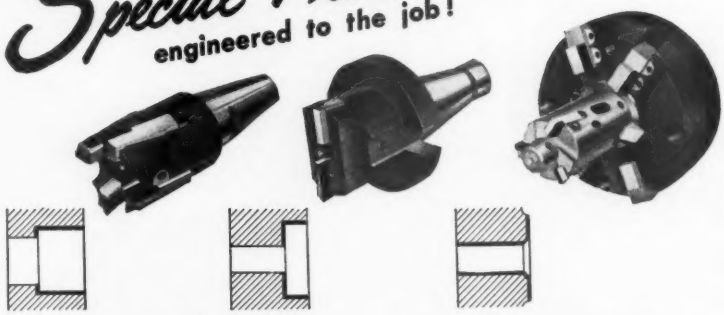
engineered to the job!



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PRODUCE BETTER WORK FASTER and at LOWER COST

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Cut your costs and increase your output with McCrosky's "Multiple Operation" specials. Engineered specially to your individual work conditions, a McCrosky Special combines 3, 4, 5 or more related operations — does them all simultaneously with one tool — and one set-up — assuring unvarying uniformity of finished product — eliminating repeated handling — reducing the amount of work in process — speeding up deliveries and producing other economies so great that they pay their way even on moderately short runs.

Write for Bulletin No. S-18. It can really save you money!

COST CUTTING TOOLS McCROSKY TOOL CORPORATION MEADVILLE, PA.

Engineering and Sales Representatives in the Principal Cities

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Universal MILLING CUTTERS	Up to four times as many blades as the cutter diameter.
Super® *Adjustable* REAMERS	15/16" to 6" in diameter.
Wizard® QUICK CHANGE CHUCKS	Change drilling tools without stopping the spindle.
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Block Type BORING BARS	Centering V-key locks cutter block accurately and rigidly
Multiple Operation TOOLS	Combine related operations speeding production and cutting costs.

CIRCLE INFORM-A-GRAM KEY NO. 1101

. . . Steel Industry, from page 106

ful techniques, the A.S.Q.C. Metals Technical Committee recently conducted a broadly comprehensive survey on a selective basis. A complete report on this survey may be found in the Transactions of the Eighth Annual Convention of the American Society for Quality Control. A return of 76 replies to 103 questionnaires directed to the highest ranking individual known to have an interest in quality control in the companies on the selected list reflects the breadth of the interest in the metals industry. The objectives of this survey were to find out what types of people were using which techniques and to what extent, as well as to disclose something about requirements or interest with respect to other techniques. Of the replies, 33% were made by metallurgists, 22% by Q.C. Supervisors, 12% by Q.C. Engineers, and 9% by Chief Inspectors. This provided a pretty good answer as to "who".

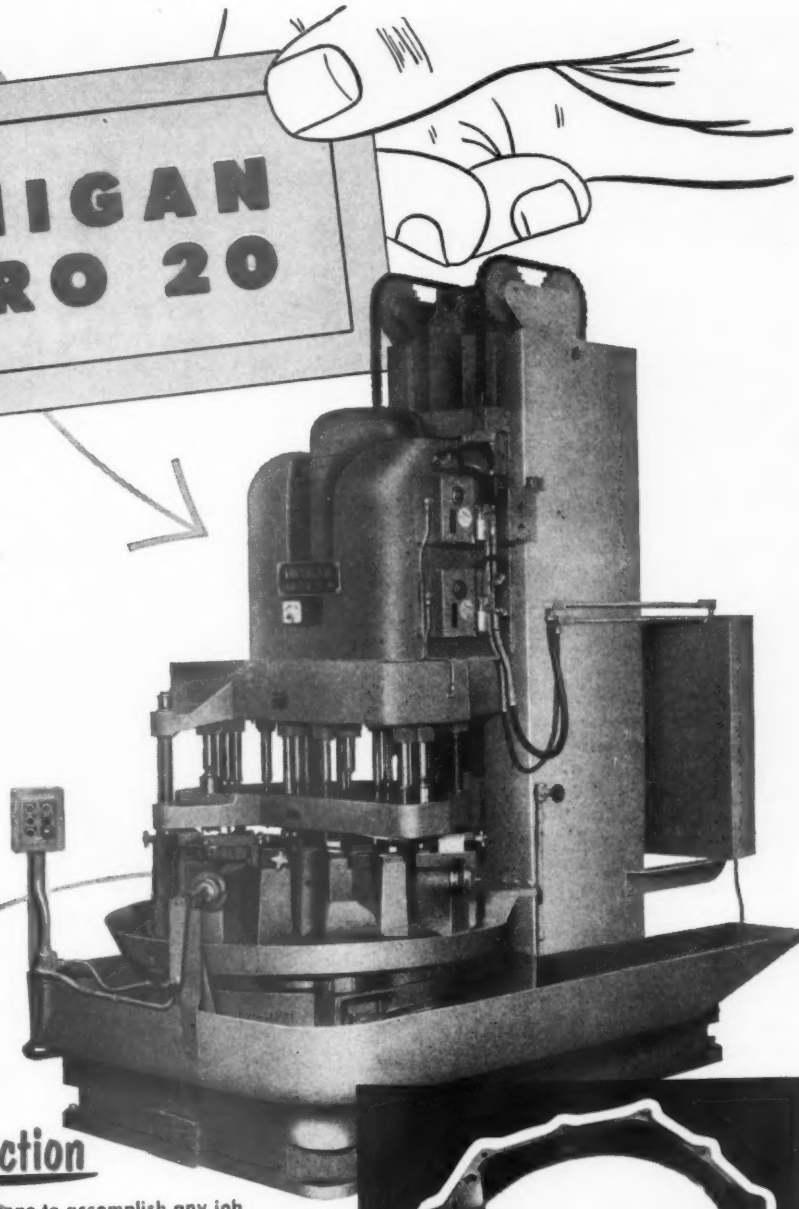
Returns were tabulated as to popularity and degree of usage of individual techniques from many different approaches. This resulted in some very definite conclusions on supply and demand. In the supply column are to be found those techniques most effective and popularly used, and in the demand column those which are not in common usage, perhaps because of unfamiliarity, but about which a desire for further information was expressed.

Thus the basis for a set of case histories was provided and it is the intent of the surveying committee to prepare and publish a set of case histories expounding the utility of the techniques about which interest was expressed. The value of a collection of practical applications, with all the attendant details and calculations, is quite obvious. The material expansion of the application of all kinds of Q.C. techniques to those many phases of the steel industry heretofore but lightly touched is a foregone conclusion.

Throughout the development of Q.C. within industry the following was repeatedly expressed by the Doubting Thomases: "Quality Control is fine; fine for you but my business is different."

. . . Continued on page 114

MICHIGAN HYDRO 20



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100 FLY WHEEL HOUSINGS PER HOUR

For Faster, More Economical Production

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We also invite your inquiries as to our line of tapping units, and index tables, both manual and automatic

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engineers and manufacturers of production machines and drilling equipment

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with GORTON MULTIPLE-SPINDLE INDEXING PANTOGRAPHS

Multiple operations with exceptional repetitive accuracy give you production-line performance on Gorton Multiple-Spindle Indexing Pantographs. From two to six different operations, performed at one setting, result in both precision and economy. Automatic cycling during engraving, milling, profiling, chamfering, counterboring, grooving or routing.

Infinitely variable feeds up to the capacity of any existing cutter. Reversing drive for conventional or climb milling.

240 Pieces Per Hour

This fuse part, of No. 1213 steel, has a serpentine groove with irregular radii. Two pantograph cutters rough out and the other two finish parts in pairs. Groove is .1903" wide, plus .0014", by .109" deep, plus .003". Finish: 35 mcr.

194 Pieces Per Hour

These die-cast spectacle frames incorporate "V"-shaped grooves or bezels for left- and right-hand lenses. The bezels do not lie in a horizontal plane but require a "rise and fall" in cutter movement to accommodate convex lenses. This machine mills grooves in both lenses automatically during the cutting cycle.

These machines are custom-built according to customers' specific requirements. With tooling changes, they have many different applications. Write for Forms 2595-DS and 2604-DS on Gorton Multiple-Spindle Indexing Pantographs.

GEORGE GORTON MACHINE CO., 1210 Racine St., Racine, Wis., U.S.A.

CIRCLE INFORM-A-GRAM KEY NO. 1121

. . . Month's Talk, from page 108

matter of mechanized control of the micrometer type of positioning mechanism used to move the wheel slide.

Some jobs are best ground if given the opportunity to round up progressively as grinding takes place. This requires a feed which is intermittent, the slide advancing, hesitating, again advancing and hesitating a number of times until the work is near to size and rounded up. It has been possible to provide control for the hydraulic operation of the wheel feed operating piston to accomplish this.

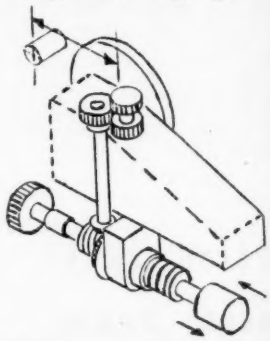


Fig. 7. Mechanism for compensating for wheel-diameter reduction.

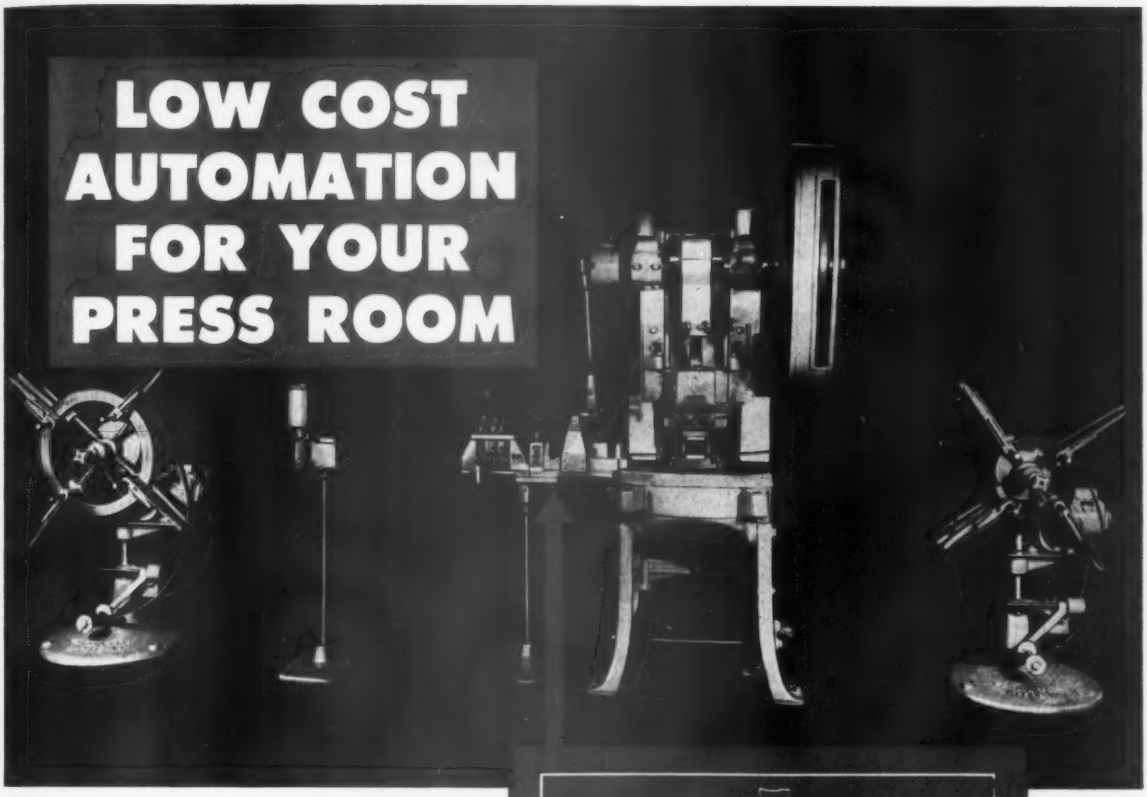
Truing The Grinding Wheel

The element of dressing the grinding wheel has been assisted greatly through the medium of a mechanized truing unit built into the machine design, which automatically provides controlled motions for traversing the diamond across the wheel face, as well as feeding the diamond to the wheel either for wheel-diameter reduction or for controlled contour. This has not been a too difficult design problem, but required evaluation that the truing unit was in itself a machine incorporated as a part of the whole machine.

Figure 6 illustrates a wheel-guard truing device which is available as an operator-controlled device or can be incorporated into an automatic cycle. Using a counting device, the truing operation can be at established intervals. When made automatic, we must provide for compensation of wheel-diameter reduction if we are to continue to experience satisfactory work-size control. In principle the

. . . Continued on page 188

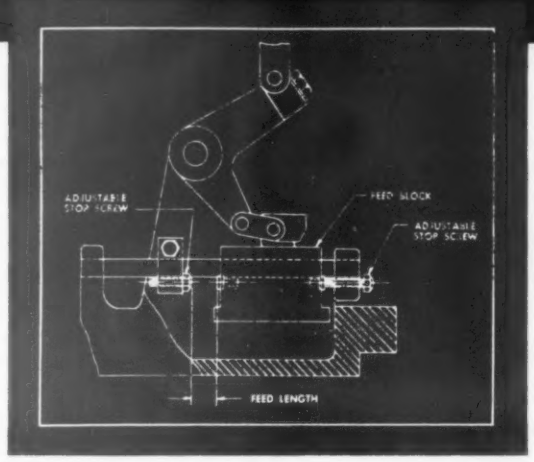
LOW COST AUTOMATION FOR YOUR PRESS ROOM



You can use U. S. Automatic Press Room Equipment to get all the advantages of automation at low cost. Illustrated is a typical set-up which converts a conventional punch press into an automatic machine by using two U. S. Automatic Stock Reels (one for unwinding the stock and one for rewinding it), a U. S. Stock Oiler and Wiper, a U. S. Plain Stock Straightener, and a U. S. Slide Feed.

A set-up like this gives you the double advantage of increased production and reduced labor costs, plus the added feature of flexibility. Within their capacity, all of the units shown can be easily adapted to handle materials varying in width, thickness and length of feed. Furthermore, U. S. Slide Feeds are designed so that the length of feed is controlled between positive stops, as shown in the drawing, providing consistent accuracy that is especially valuable in progressive die operations.

If you want to reduce costs and speed output in your press operations we suggest that you investigate the many advantages of U. S. Automatic Press Room Equipment. Bulletin 80-P gives essential facts about the complete line. Send for your copy.



Positive Feed Length Adjustment

The drawing above shows how, in the U. S. Slide Feed, adjustments for feed length are controlled between positive stops. This feature assures controlled accuracy of feed length—an especially important factor in progressive die operations.

U.S. TOOL COMPANY, Inc.

AMPERE (East Orange) NEW JERSEY **Builders of U. S. Multi-Slides — U. S. Multi-Millers**
U. S. Automatic Press Room Equipment — U. S. Die Sets and Accessories

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Plastic DRAWER JIFFY CABINETS

THE BEST WAY TO PUT SMALL ITEMS IN THEIR PLACE!

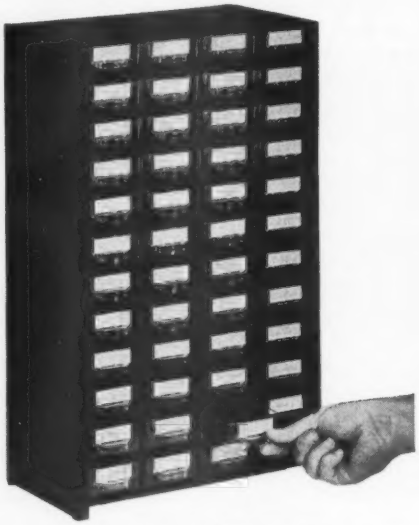
In every home, in every office, in every shop, there are dozens of small parts requiring easy, convenient storage. The slickest, handiest answer to this problem is the JIFFY Cabinet.

CHECK THESE FEATURES:

• **3 New Color Combinations**
Cocoa Brown with tan drawers.
Black with gray drawers.
Red with crystal-clear drawers.

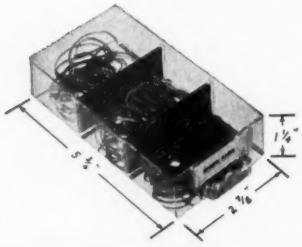
• **Solid One-piece Back Panels**
Keep dust out . . . maximum strength girder type construction . . . ready-made keyhole slots for handy wall mounting.

• **Rubber-tipped Cabinet Feet**
Prevent scratching . . . increase stability . . . make stacking convenient.



Illustrated — 48-drawer JIFFY Cabinet, red frame with crystal-clear styrene drawers.....only $19.95*

• **Generously Sized Drawers**
More than 18 cubic inches in each one . . . full set of index labels and drawer dividers supplied with every cabinet.



Inside of drawer easily divided into three compartments with metal dividers as illustrated. Each drawer has a stop to prevent accidental spillage and to permit drawer to hang open from back edge. Ribbed runners on bottom of all drawers permit them to slide freely. Index slots on front of drawers allow easy identification of contents.

HANDY PRODUCTS, P. O. BOX 2447, CLEVELAND 12, OHIO

Please send immediately the quantity, size and color JIFFY units as listed:

☐ 48 Drw. @ $19.95* ☐ 32 Drw. @ $12.95* ☐ 24 Drw. @ $9.95* ☐ 16 Drw. @ $7.95*

☐ Red w/clear drwrs. ☐ Black w/gray drwrs. ☐ Brown w/tan drwrs.
(NOTE: If color is not specified, we will ship Red Cabinet w/clear drwrs.)

WE PAY ALL SHIPPING COSTS

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Open account shipments on company purchase orders. Otherwise, check with order, please. No C.O.D.'s, please. *Ohio customers add 3% sales tax.

. . . Steel Industry, from page 110

This was heard no less often from the steel industry than from any other. Continued determination has shown that while the actual application of the techniques may have been a little different, the underlying philosophy was not.

Because the basic processes of the steel industry are so complex, twenty or thirty inter-reacting variables being common, those techniques particularly designed for studying such conditions can be of tremendous value. The techniques of multiple correlation and analysis of variance are probably the most powerful of all the tools but are likewise the most narrowly understood or appreciated. The successful utilization of these techniques admittedly requires a little more than average training but the results of their use can be highly rewarding.

All too few Q.C. engineers wrestling with problems of application appreciate the potential value of the simplest of all these tools, the control chart and the frequency distribution. Dividends can be unbelievably high from simple "on the job" controls. The ability to see in picture form where we are now, today, compared to where we were yesterday, or the ability to recognize the mistakes of today and have some measure of them so as to avoid making those same mistakes tomorrow, can not be overemphasized. These tools are simple to use, simple to explain and readily understood by department personnel. They are far reaching in their effects on general quality improvement when courageously used.

The past two years, particularly, have demonstrated to an increasingly large number of plant operating personnel that there is widespread practical application for not only the more advanced but also the simple technique. At this point appears another vital factor in the picture, i.e., management reaction. In this respect the steel industry differs but little from other industries. Management reaction is found to vary from being highly enthusiastic and actively supporting, down to being completely indifferent. The majority appears to

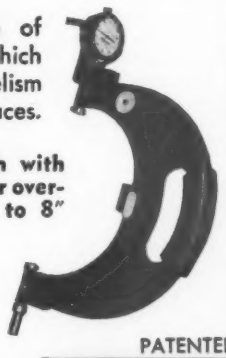
. . . Continued on page 216

NEW!

PARALLOC Dial Snap Gages "D" (Direct) TYPE

Introducing a new type of pin locking mechanism which maintains constant parallelism between anvil faces.

8 SIZES, each with 1" range, cover over-all range 0" to 8"



PATENTED

NEW!

PARALLOC Dial Snap Gages "L" (Lever) TYPE

Fully encased movement and indicator protected against damage. Set-back indicator and handle permit entry into narrow recesses. Wide choice of indicators.

8 SIZES, each with ½" range, cover over-all range 0" to 4"

PATENTED

NEW!

Dializers®

STANDARD's original device for converting AGD Adjustable Limit Snap Gages to *DIAL* Snap Gages now available with wide range of indicators from 1⅛" to 2¼" diameter, graduations of .001", .0001", .0005" and .00025", and a wide variety of dial markings, including metric.

Available separately for your frames or assembled in AGD frames supplied by us.

PATENTED

PATENT APPL. FOR

NEWS! STANDARD GAGE presents a number of NEW PRODUCTS

each deliberately designed to help you do a better job

NEW!

Dial Bore Gages

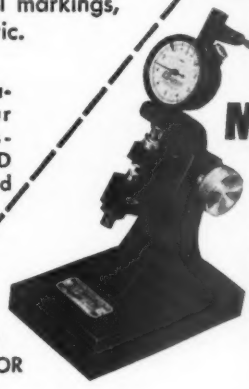
Three new models extend dial bore gaging range by intermediate steps down to ⅛" diameter. Each utilizes STANDARD's new, highly practical CENTERING-SIZE DISC principle. Simple in design, easy to set, easy to use, but amazingly accurate and effective in small bore gaging.

STANDARD Dial Bore Gages now available in 10 sizes covering range from ⅛" to 24"

PATENT APPL. FOR

NEW!

PARALLOC DUAL THROAT Midget Dial Comparator



A most useful and versatile gaging instrument. Upper throat is deep, for measuring flat work pieces and stock. Lower throat designed for gaging small round or cylindrical pieces. Three-eighth inch range. May be used as dial comparator at inspection bench, or gage may be detached and brought to work piece like a dial snap gage.

We invite your investigation and trial of these new gages, each designed to help YOU.

STANDARD Gage Co., Inc.
Poughkeepsie, N.Y.

Write for brochure on "NEW PRODUCTS" for more complete details on these instruments.

CIRCLE INFORM-A-GRAM KEY NO. 1151

MEN YOU SHOULD KNOW

Charles E. Schell has been appointed Assistant to the Plant Manager of John Volkert Metals Stampings, Inc. Mr. Schell has been associated with Sylvania Electric Products, Inc., for 25 years.

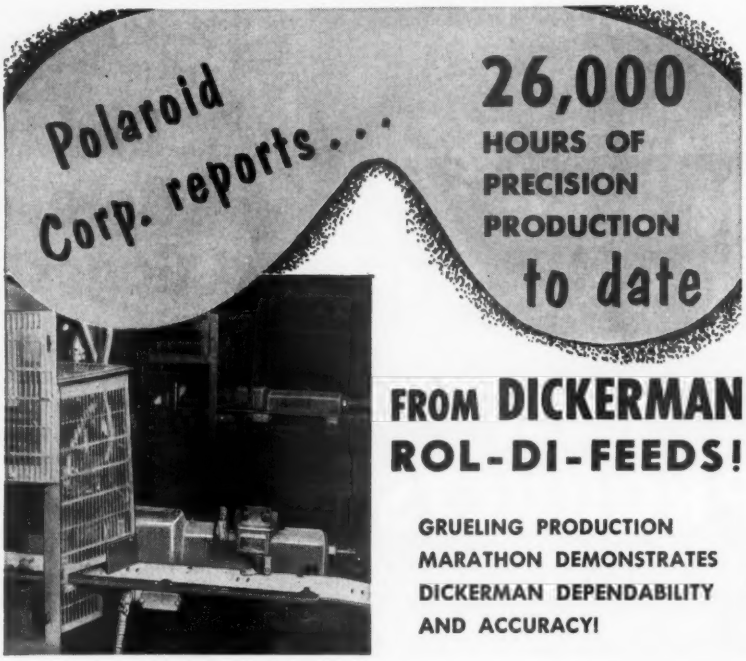
◆

The Morris Machine Tool Company has announced the appointment of **Carl W. Larrick** as Works Manager. Mr. Larrick has been with the firm the past four years and was formerly Production Control Manager.

The Hallden Machine Company, Thomaston, Conn., announces the appointment of **John Upton, Jr.,** as General Manager. Mr. Upton comes to Hallden from the Wean Engineering Co., Inc., Warren, Ohio.

◆

The Warner & Swasey Company announces the appointment of **Lester M. Cole** as General Sales Manager with headquarters at the main office in Cleveland. He was previously Southern District Manager.



FROM DICKERMAN ROL-DI-FEEDS!

GRUELING PRODUCTION MARATHON DEMONSTRATES DICKERMAN DEPENDABILITY AND ACCURACY!

3 years of unfailing service — 24 hours per day — with no overhaul or appreciable maintenance — is the phenomenal record established by Dickerman Rol-Di-Feeds in the Sun Shield Department of the Polaroid Corp. More than 70,200,000 pieces have been produced . . . the original feeds are still in daily operation and . . . are expected to outlast the die itself.

Feeding .030" polarizing lens stock at 30-60 strokes per minute (depending on requirements) the Rol-Di-Feed activates optically perfect material that must be fed and blanked to micro-tolerances without the slightest trace of scratching or marring.

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CIRCLE INFORM-A-GRAM KEY NO. 1161

John Haller, formerly Vice President in charge of research and engineering at Allied Products Corporation in Detroit has now organized Haller, Incorporated in Plymouth, Michigan. His new firm will handle sales and engineering connected with hydraulic and mechanical presses for powdered metal, pharmaceutical, chemical, and plastic processing. In addition to sizing and tableting presses, of Mr. Haller's design, the firm will import several lines of European presses and other processing equipment.

◆

Robert L. Lewis, formerly Assistant Manager of Manufacturing Control at TEMCO Aircraft Corporation, has been named Assistant Director of Contract Administration for the Dallas, Texas company. Mr. Lewis replaces **E. Fred Buehring** who was recently promoted to Plant Manager of TEMCO's overhaul and modification center at Greenville, Texas.

◆

Promotion of **Stephen L. Ingersoll** to the post of Executive Vice President of the Ingersoll Steel Division of Borg-Warner Corp. has been reported. Mr. Ingersoll previously was Vice President and Treasurer. Other major executive promotions within the division were: **Harold G. Ingersoll, Jr.,** previously Assistant to the President, elected Vice President and Secretary; **Ralph W. Leigh,** also formerly an Assistant to the President, named Vice President in charge of sales; and **William C. Zepf,** previously Assistant Secretary, now named Treasurer.

◆

Weller Electric Corporation, Easton, Pa., announces the appointment of **Joseph F. Whitaker** as Vice President in charge of sales. In his new capacity, Mr. Whitaker will plan and supervise the national promotion and sales of Weller soldering guns, soldering kits and power sanders.

◆

William Irrgang was elected President and General Manager of the Lincoln Electric Company of Cleveland at a recent meeting of the Board of Directors. **James F. Lincoln,** elected Chairman of the Board, will remain active in the direction of company policies. **John C. Lincoln,** founder of the company, now living in Phoenix, Ariz., was elected Honorary Chairman of the Board and Treasurer. Other officers elected were **John S. Roscoe,** Executive Vice President; **A. F. Davis,** Vice President and Secretary; and **George Landis,** Vice President.

MEN YOU SHOULD KNOW

Clearing Machine Corporation of Chicago has opened a direct factory office in Rochester, N. Y. to serve the upper and western parts of the state. In charge of the new office will be **Robert J. Falsey,** who has been associated with Clearing since 1945 and has had a broad background of experience in metal-forming problems.

◆

Howell W. Murray has been elected to Gisholt Machine Company's Board of Directors. In addition to being a member of the Madison, Wis. firm's governing body, Mr. Murray is Vice President and Director of A. G. Becker & Company, Chicago; Director of the Gardner-Denver Company, Quincy, Ill.; Director of the Parker Pen Company, Janesville, Wis.; Trustee of the University of Chicago; and Trustee of Carlton College in Northfield, Minn.

◆

I. Wendell Hamm has been named Director of Manufacturing for the Carborundum Company. Formerly Mr. Hamm was Chief of Industrial Engineering for DuPont's Nylon Division.

◆

Appointment of **Virgil C. Rice** as Director of Manufacturing of the Norge Division of the Borg-Warner Corporation has been announced. The appointment brings Mr. Rice back to Norge after an 11-year absence. He spent the 16 years between 1927 and 1943 as an executive in Norge's manufacturing operations. He now comes to the company from Ronson Art Metal Works of Newark, N. J., where he has been Vice President in charge of manufacturing.

◆

The appointment of **Alfred Sugar,** until recently Aluminum Division Plant Manager for the American Metal Co., Ltd., as Vice President and Technical Director of Alloys & Chemicals Mfg. Co. in Cleveland has been announced. The author of many technical papers and college lecturer, Mr. Sugar has had almost 30 years experience in metallurgy.

◆

Gordon S. Turnage, Supervisor of Estimating at the Chrysler Detroit Tank Plant since October, 1952, has been named Manager of Estimating and Routing. Another appointment at Chrysler concerns **Aloysius C. (Al) Breitenbeck,** who has been on Special Assignment at the Detroit Tank Plant and in Defense Operations. He has been named Manager of Process and Methods.

Bryant Chucking Grinder Company of Springfield, Vt., has announced the appointment of **Joseph E. Smith, Jr.** as Manager of its Gage and Spindle Division.

◆

Kenneth P. Martin, formerly Sales Manager of the Process Machinery Division of Cincinnati Milling Machine Company, has been appointed General Sales Manager of National Automatic Tool Company, Inc., of Richmond, Ind.

A. W. Morgan, formerly Executive Vice President and General Manager of Pachmayr Gun Works, Inc., Los Angeles, has joined Convair in San Diego as Assistant to the Manager.

◆

Returning to Milwaukee from Houston, Texas, where he had most recently been manager of the LPG Division of the A. O. Smith Corporation, **George E. Kemper** has been appointed General Manager of the firm's Welding Products Division.

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INCREASE tool life- speeds - feeds
HYPREZ
High Precision DIAMOND COMPOUNDS
Strongly-graded pure diamonds, uniformly dispersed in the unique Hyprez vehicle produce a perfect finish quickly, on gages, molds and dies. They also more than double tungsten-carbide tool performance on many jobs and materials.
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SPITFIRE
Precision
LAPPING MACHINES
• Precision
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at Low Cost!
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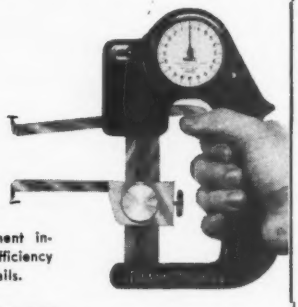
Anderson Machine Tool Co. — St. Paul, Minnesota
Harron, Rickard & McCone — San Francisco, Calif.
Rudel Machinery Co., Ltd. — Toronto, Vancouver, Montreal, Windsor, CANADA

CIRCLE INFORM-A-GRAM KEY NO. 1181

DIAMETRICK CALIPER-GAGE

"A New Trick For Checking I.D.'s"

- Wide Range
- Multi-purpose
- Trouble-free
- Ideal for "O" Ring Grooves



A precision measuring instrument invaluable for speed, accuracy, efficiency and economy. Write for details.

ALSO

DESIGN AND PRODUCTION OF SPECIAL MULTI-STATION PARTS:

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Special research work to integrate these methods into your automation plans. Complete information available.

MUTUAL ENGINEERING SERVICE
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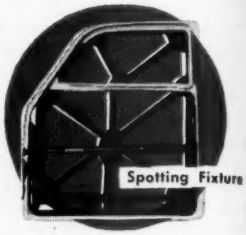
CIRCLE INFORM-A-GRAM KEY NO. 1183

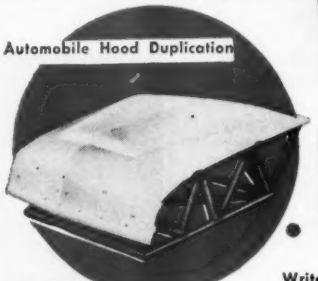
Engineered... To YOUR Tooling NEEDS

Ren-ite*, the great dimensionally stable tooling plastic, has been tested and proved by years of research and development. The Ren-ite organization offers unrivaled facilities to help industry cut up to 70% tooling time and 50% of costs.

You can be SURE when you use Ren-ite modified epoxy resins for master Keller models, skin panels, checking and welding fixtures, dies and prototypes, or other tooling applications.



Spotting Fixture



Automobile Hood Duplication

Some of the many uses of Ren-ite tooling plastic and standard stock plastic tubing.

● FREE ENGINEERING SERVICE—NO CONTRACTS REQUIRED

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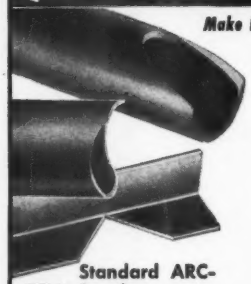
OFFICES IN CHICAGO, CLEVELAND, DETROIT, LOS ANGELES, NEW YORK AND ST. LOUIS.

*"Ren-ite," "The Dimensionally Stable Tooling Plastic" and "Comminuted for Quality" are Trademarks of Ren-ite Plastics, Inc.

CIRCLE INFORM-A-GRAM KEY NO. 1182

Notch 12 PIPE ENDS per MINUTE

Make Perfect Joints for Welding or Brazing



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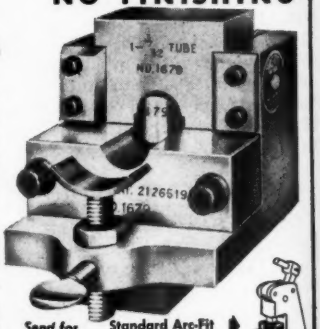
NOTCHES CLEAN
NO FINISHING

Standard ARC-FIT in hand or power press shears contours for "T" joints for ½" to 2" pipe or tubing with easily interchanged dies.

Special ARC-FITS for larger sizes, angles other than 90°, slotting or notching square pipes, angle iron or flat stock.



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Standard Arc-Fit works well in our special HAND PRESS

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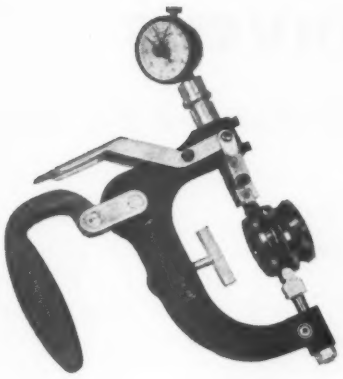
CIRCLE INFORM-A-GRAM KEY NO. 1184

INDICATING SNAP GAGE BUILT FOR LONG LIFE

Long-Life Indicating Snap Gages, made by Foster, feature built-in compensation for wear. Tungsten carbide gage points are ground and lapped parallel for positive gaging action. The gage is easily adjusted to the master; and the gage frame is of malleable iron so as to "stay" with the master during temperature changes.



Shown is an adaptation of the snap gage for accurate measurement of pitch diameter or O.D. of splines and gears, depth of keyway, or other dimensions normally "miked" over pins or balls. Thumb pressure elevates the upper contact point for clearance in engaging or disengaging the piece being measured.

Further information may be obtained from Foster Engineering Corp., 4200 N. Woodward Ave., Royal Oak, Mich., or—
Circle Inform-A-Gram No. D5.

OHIO FIRM OBSERVES 50TH ANNIVERSARY

The 50th Anniversary of the founding of The Motch & Merryweather Company, Cleveland, Ohio, was marked last month. The founders, George E. Merryweather, Edwin R. Motch, and Stanley Motch, all graduates of Massachusetts Institute of Technology who served their apprenticeships in eastern metalworking plants, formed the company to serve as distributors of machine tools for leading machine tool builders in Ohio and eastern Michigan.

This area was later expanded to include part of Pennsylvania and Maryland and all of Kentucky. Branch offices have been established in Detroit, Pittsburgh, Cincinnati, and Dayton. The original office had a staff of four employees; now the employee roster lists 500, including office, sales, and factory.

The company operates six divisions, the largest of which is the Machine Tool Distributor Division. The Cutting Tool Distributor Division sells cutting tools and machine tool accessories, and a line of diversified types of machine tools under the Motch & Merryweather name are built in the Machinery Manufacturing Division. Other divisions handle used machinery and rebuilding, cutting tool manufacture, and the production of multi-purpose power garden tools.

Two second-generation executives now carrying on the work of the Motch & Merryweather founders are E. Franklin Motch president and treasurer, and George E. Merryweather, vice-president and secretary.

Backed By Years of Experience in the MANUFACTURE of CUTTING TOOLS...

THE CLARKSON CUTTER GRINDER

Simplicity . . . Speed . . . Economy are featured in the Clarkson Cutter Grinder . . . designed specifically for use in the manufacture of Clarkson Milling Cutters. All of the desirable features recognized as essential through years of experience, to the manufacture of cutting tools are incorporated into the Clarkson Cutter Grinder, yet it is low in cost, *right* for use in *your plant* for resharpening

- ★END MILLS
- ★SLOT DRILLS
- ★REAMERS
- ★WOODRUFF CUTTERS
- ★T-SLOT CUTTERS
- ★COUNTERBORES
- ★COUNTERSINKS
- ★SPOT FACING CUTTERS
- ★SIDE AND FACE CUTTERS
- ★CYLINDRICAL CUTTERS
- ★FACE MILLS
- ★ANGLE CUTTERS
- ★and HOLLOW MILLS

Write today for FULL INFORMATION on the Clarkson Cutter Grinder . . .

Clarkson, Incorporated
4004 East 8 Mile Road
Detroit, Michigan

Gentlemen:

Please send full information and prices on the Clarkson Cutter Grinder.

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COMPANY.....

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Can be obtained through your local distributor.

DEDLOCK CHUCKS • AUTOLOCK CHUCKS • MILLING CUTTERS • CLARKSON CUTTER GRINDERS

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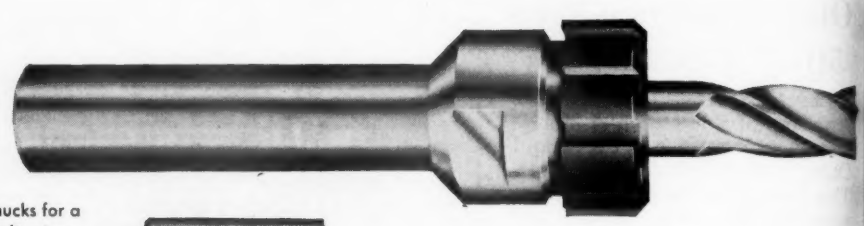
CIRCLE INFORM-A-GRAM KEY NO. 1191

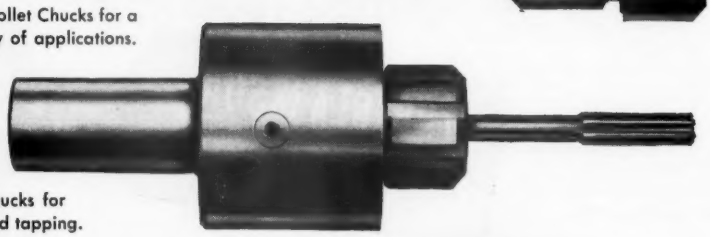
UNIVERSAL CHUCKS

SAVE TIME • SAVE MONEY

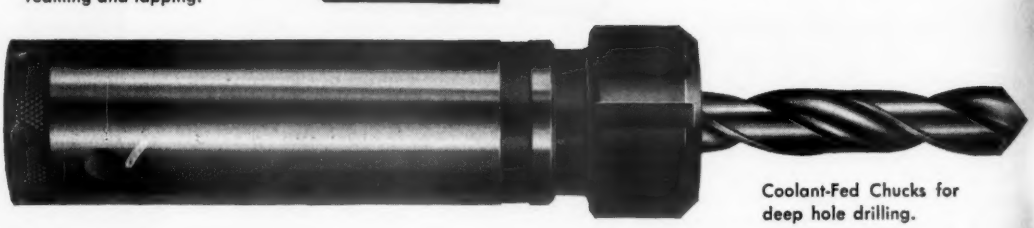
- low first cost, due to simple design.
- wrap-around gripping action eliminates scored tool shanks.
- precision manufacturing assures tools running true.
- sizes from 1/16" to 1½", shanks to fit any type machine.



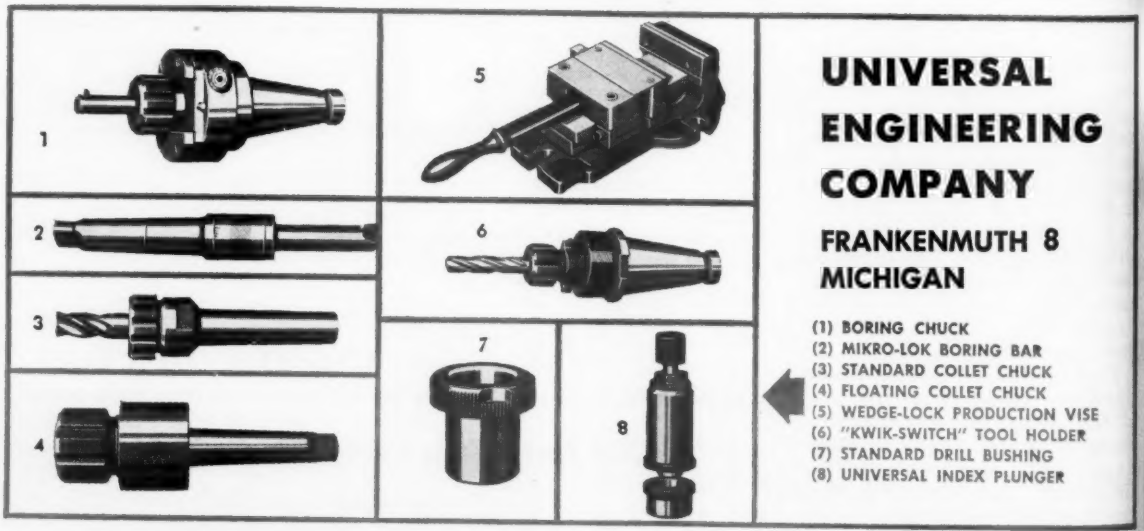
Standard Collet Chucks for a wide variety of applications.



Floating Chucks for reaming and tapping.



Coolant-Fed Chucks for deep hole drilling.



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(7) STANDARD DRILL BUSHING
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CIRCLE INFORM-A-GRAM KEY NO. 1201

He isn't on your payroll.

He doesn't have a drawing account.

He doesn't have a desk in your office.

Nor a spot in your shop.

Yet he's been around quite a while.

He knows more about more things than you can shake a stick at.

His experience is infinite and his contacts are legion.

Best man you ever had working for you...

Quite a fellow!

You know him when you see him face to face.

To turn him around, turn this page.

He is an indispensable factor in the economy of the industrial world . . . the expediter who keeps hand and power tools, machine parts, accessories and manufacturing staples coming in order to keep plants going.

He is your nearest, quickest, most dependable source of supply. No other system of procurement has yet been devised to assure smoother, uninterrupted industrial operation.

The Industrial Distributor carries a myriad assortment of active items — in types, designs, grades and sizes to meet your specific needs as well as the needs of other manufacturers from whom you buy equipment, materials, assembly units and other production needs.

He also warehouses countless items of long-interval demand which otherwise would tie up your own capital—or expose you to the risk of slow-up or shut-down.

He knows where and how to obtain scarce or sorely needed requisites—thus sparing you the time and expense of searching for them yourself.

He explores the globe for new and improved appliances that may speed up your production, cut your costs, improve your product.

He is a veritable "encyclopedia" of information for keeping you up to date on new practices, processes and paraphernalia.

As a "clearinghouse" for your purchases from all sorts of producers far and near, your Industrial Distributor relieves you of a lot of accounting and other "paper work." By similarly serving such producers in their distribution, he ultimately brings you still further benefits.

. . . he represents your Industrial Distributor

• Nicholson believes in and has adhered to this principle of MARKETING THROUGH SERVICE for more than 40 years. As a result, Nicholson Distributors and their field men learn how to WORK FOR YOU. They become experts on files and filing—right down into your shop where the right use of THE RIGHT FILE FOR THE JOB counts in the way you want it to count. • There are throughout the U.S. more than 875 near-at-hand Industrial Distributors of Nicholson and Black Diamond files; and over the years few of them ever leave us—or you.

NICHOLSON FILE COMPANY

PROVIDENCE 1, RHODE ISLAND

(In Canada: Nicholson File Company of Canada Ltd., Port Hope, Ontario)

World's foremost manufacturer of

A FILE FOR EVERY PURPOSE

IT TAKES A 3-POINT SPECIFICATION TO INSURE SURFACE PLATE FLATNESS

by R. J. Rahn, RAHN GRANITE SURFACE PLATE CO., Dayton, Ohio

USERS AND MANUFACTURERS of surface plates are having the same difficulties as were experienced by manufacturers of metal products at the start of the interchangeable parts era which has led to our present mass production. Prior to that era it was thought that the reason Smith & Co. made a superior gadget was because Smith had somehow been able to instill his craftsmanship and feel into his few employees. It was all a matter of individual skill, individually attained or individually trained.

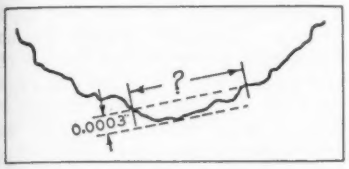


Fig. 1. A "flat" surface plate could actually be shaped like a pretzel and still conform to a 1-point specification of merely 0.0003".

Then with the revolutionary idea of manufacturing tolerances came the first real progress, even though the tolerances were a crude "1/32 scant" or "1/32 full". There at least was something that could be written into a specification or tolerance, even though the meaning of "scant" and "full" varied with the individual craftsmen. Now Jones & Co. could close up the gap between themselves and Smith & Co. because Mr. Jones could provide his mechanics with written instructions. Highly skilled craftsmen became that much less necessary.

As better equipment was developed, better products were designed to closer tolerances, and the tolerances more accurately defined as better measuring instruments also were developed.

Parallel Development In Surface Plates

While the surface plate has been honored as being the very foundation of our present era of interchangeable parts manufacturing, there has up until now been no comprehensive specification or tolerance for the flatness of the surface. Until quite recently, Smith & Co., who had the skilled craftsmen with that certain feel, made surface plates that were considered superior. Try as they would, Jones & Co. could not get the same acceptance of their surface plates, although they sold a reasonable quantity at lower prices than Smith.

With the advent of granite surface plates, the manufacturers thereof referred to "accuracy". While this was specified in ten-thousandths and even twenty-thousandths of an inch, it had less meaning than the "1/32 scant" and "1/32 full" of the early days of dimensional tolerances. While the "scant" and "full" tolerances would prevent individual interpretations from equalling 100% of the unit used (1/32"), the individual interpretations of "1-point specifications" on surface plates could permit several hundred percent greater errors than the unit specified.

For example, Figure 1 shows a cross section of a surface that

. . . *Continuer on page 124*

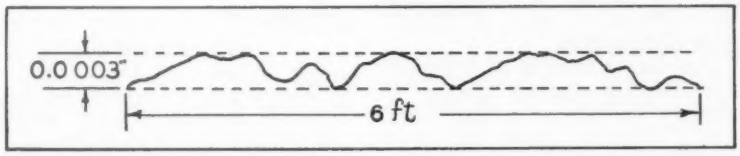


Fig. 3. Although all points on the plate surface lie between two parallel planes separated by a specified distance, possible errors in measurement can equal 200% of the specified distance.

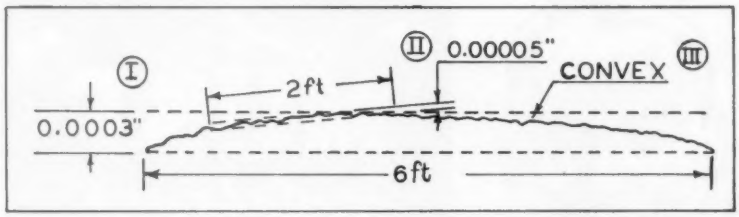
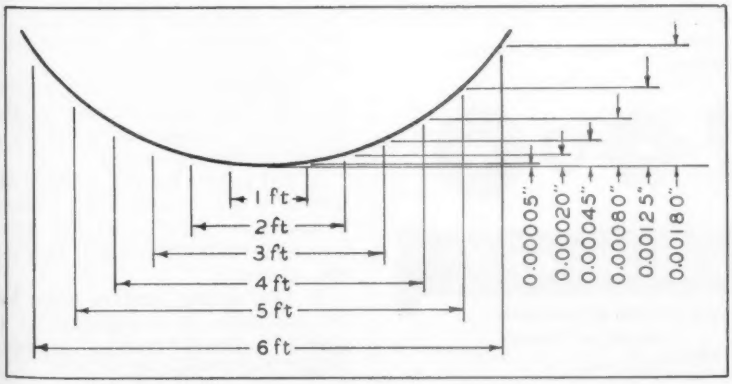


Fig. 4. It takes these three critical specifications for surface plate flatness in order for measurements to be held to an error amounting to less than the over-all accuracy of the plate.

Fig. 2. Even the addition of a "per foot" limit to the hill and dale specification of a surface plate will not prevent an accumulated error of 3600% in the case of a 6-ft. surface plate made to a 1-point flatness specification of 0.00005" per foot.



. . . Surface Plate, from page 123

would pass a "0.0003" accuracy" specification where no further limitation was contained in the specification. How much over-all error this would permit was limited only by each individual's concept of the undefined area over which an error of 0.0003" was permissible.

Another example of a 1-point specification was an attempt to specify flatness on a "per foot" basis. Figure 2 shows the cross-section of a surface that would pass a "0.00005" per foot" specification. The maximum permissible over-all errors for the various lengths shown are based on the geometry of the sphere. For such very small curves the chord height is approximately proportional to the square of the chord length, or

$$\frac{H_1}{H_2} = \frac{(L_1)^2}{(L_2)^2}$$

Therefore, a uniform error of 0.00005" in one foot would permit an over-all error in 6 feet of 36 times the per-foot error, or 0.0018". Here is a possible error of 3600% of the unit used. Compare that to the less than 100% of the "scant" and "full" days.

Still another attempt at a 1-point specification is this, "All points on the surface shall lie between two parallel planes separated by a specified distance". This amount was called the "accuracy of the plate". Figure 3 shows a cross section of a surface plate which could meet such a specification, i.e., 0.0003", as customarily used for a 6-ft. surface plate. Any object placed on such a plate would rest on the high points. If a stack of gage blocks happened to be placed on one of the peaks while the height gage was in a valley, the indicator zero setting would actually be the height of the gage blocks plus 0.0003". If a subsequent measurement was taken with the height gage on a peak, an error of minus 0.0003" would occur in the measurement. Likewise, if the positions of the gage blocks and height gage were reversed, it would make possible an error of plus 0.0003" on a measurement. Thus possible errors could be made equal to 0.0006" or 200% of the specification. Again, compare this to the less than 100% of the "scant" and "full" days.

A Comprehensive 3-Point Surface Plate Specification

In order to adequately describe the black granite surface plates it is making, Rahn Granite Surface Plate Company has found it necessary to write a "3-point specification". This specification can readily be understood by any one and interpreted in exactly the same manner by all. With this specification, a user has the assurance that errors will be not over 100% of the unit being used. Refer to Figure 4 while reading the following specifications for a 6-ft., grade AA, Rahn granite surface plate.

1. All points on the entire surface shall lie between two parallel planes separated by 0.0003", (See I in Figure 4) and

2. All points on the surface of any 2 ft. x 2 ft. area shall lie between two parallel planes separated by 0.00005", (See II in Figure 4) and

3. The entire surface shall be in the form of a segment of a quite uniform convex sphere. (See III in Figure 4).

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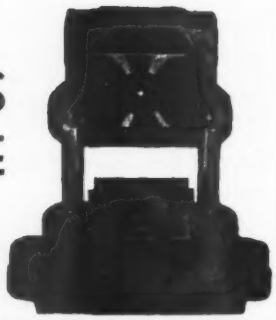

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Made in 5 sizes:
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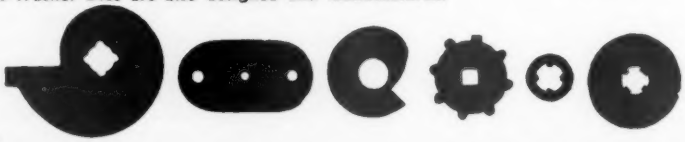

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CIRCLE INFORM-A-GRAM KEY NO. 1241

The worst error in measurement that could possibly occur on a surface plate made to these specifications, and as shown in Figure 4, would be in the exceptional case of an object equal to the length of the plate and supported only at the extreme ends. With gage blocks on a 0.00005″ peak and height gage in a valley, an error of minus 0.00005″ would be possible in the indicator zero setting. A measurement then taken near the center of the plate could show an additional minus 0.0003″, for a maximum possible error of minus 0.00035″. However, very few objects occupy the full length of surface plates, since the plate chosen must be large enough so that measuring instruments may be moved around the object. If the object is 2/3 the length of the plate, the error will be 4/9 of 0.0003″, or only 0.000117″. This derives from the equation given in the discussion of Figure 2.

In actual use, any large object placed on such a uniformly curved plate would quite probably conform to the curvature by sagging 0.0003″ at the ends. Thus measurements could be taken accurate to plus or minus 0.00005″. This means a possible total error in measurement of 0.0001″, or 33-1/3% of the over-all accuracy of 0.0003″. Now, at last, we are better off than with the possible 100% of the tolerance unit as offered by "scant" and "full".

Why Convex?

Of course, the convex curvature specification could be changed to concave without any loss of accuracy in measurements; and in the case of a large object supported only at the ends, as mentioned above, the maximum possible error would then be plus 0.00035″. However, if uniform curvature only was specified, without the convex (or concave) stipulation, then there could be errors (as between two surface plates, one concave and one convex) of 0.0007″; one plate plus 0.00035″, the other minus 0.00035″.

The reasons that we are offering convex surface plates are two. First, the most use, and hence wear, occurs near the center of a surface plate. Any initial wear on a convex plate tends to improve its accuracy; whereas a concave plate becomes more concave with wear. Second, any heavy loads generally are positioned near the middle of a surface plate. Any slight deflection so caused will improve the accuracy of a convex plate; it will make that of a concave plate worse.

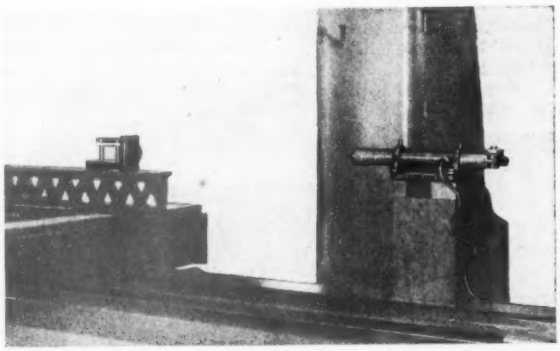
Surface Plates Now Being Made To 3-Point Specification

We have been making black granite surface plates to the 3-point specification described above for nearly four years. The surfaces are inspected with a Microptic Auto-Collimator, the only known instrument for independently determining straightness for large sizes. This instrument is capable of measurements accurate to five-millionths of an inch, using a reflecting mirror mounted on a 5″ sine bar; and even closer than this if necessary and a shorter sine bar used. The auto-collimator is used by practically all government agencies requiring an absolute measure of straightness, and by an increas-

... Continued on page 140

Microptic Auto-Collimator checks flatness at Rahn Granite Surface Plate Co.

- Tests straightness, parallelism, squareness or angles.
- Checks in any plane—horizontal, vertical, inclined.
- Portable, universal, independent of mechanical wear.



Microptic Auto-Collimator checks straightness of ways at DeVlieg Machine Company—used also for checking indexing of tables and other applications.

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PUBLICATION

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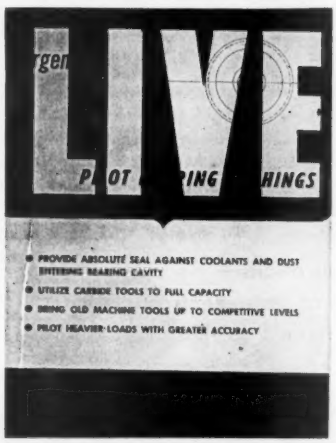
"Lubrication Properties and Industrial Applications of Pure Molybdenum Disulfide" is an illustrated reprint of a technical paper presented before the American Society of Lubrication Engineers. The reprint is made available to TOOLING & PRODUCTION readers by The Alpha Corp., Greenwich, Conn.
Circle Inform-A-Gram No. B1.

Metal Cleaning Machines. A new cold solvent type, metal cleaning equipment catalog is now available from the Graymills Corp., 3705 N. Illinois Ave., Chicago 13, Ill. Among the units described is the "606" which is a new carburetor and metal cleaner that has absolutely no lingering disinfectant odor; nor does it produce an uncomfortable skin burning sensation.
Circle Inform-A-Gram No. B2.

A New "Micro-Feed" using a planetary roller system has been incorporated into an improved 8" manual feed drill press. The quill return counterbalance has been changed from an arm to pulley and weight arrangement. The combination results in a super sensitive machine for drilling fine holes. Want more information? Then send for the bulletin on the high precision press offered by the Electro-Mechano Co., 261 E. Erie St., Milwaukee, Wis. **Inform-A-Gram No. B3.**

Cost Cutting Applications of live pilot bearing bushings are illustrated and described in this catalog available from J. G. Jergens Division of Donley Products, Inc., 11106 Avon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• UTILIZE CARBIDE TOOLS TO FULL CAPACITY
• BRING OLD MACHINE TOOLS UP TO COMPETITIVE LEVELS
• PILOT HEAVIER LOADS WITH GREATER ACCURACY

Ave., Cleveland 5, Ohio. Illustrated are precision piloting applications of Jergens live bushings on boring mills, radial drill presses, and milling machines.
Circle Inform-A-Gram No. B4.

The Micromatic Hone Story. An attractive 28-page booklet has just been issued by the Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich., on the occasion of its 25th anniversary. The booklet tells the story of the company's growth from that of an infant in the field of honing in 1929 to its present position as a world leader in that field.
Circle Inform-A-Gram No. B5.

A New Portable Device for duplicating on engine lathes is described in an illustrated booklet prepared by D. C. Caufield Copy-Master, Manchester, Conn. Subjects discussed include the duplicating of close tolerance intricate contours, including curve into curve and curve into angle. Engineering and template services are also described.
Circle Inform-A-Gram No. B6.

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Nothing

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outperform all others of this type. They combine the fast cutting action of resinoid bonded wheels with resistance to grooving approaching that of metal bonded wheels. Great durability is another advantage.

Production Grinding of Single Point CarbideTools is most economical and efficient with Norton vitrified bonded diamond wheels. Grinding chip breakers, as illustrated, is another important job for which they are ideal.

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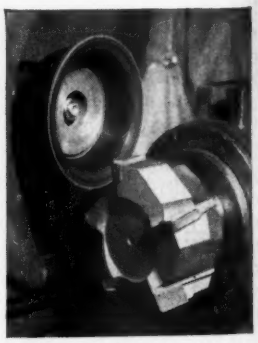
combine fast cutting with long, money-saving wheel life that makes them favorites for precision sharpening. Made in two bond types — regular, for wet grinding and B6, for dry grinding. It is always more economical to use each bond type on the applications for which it is best suited.



On Your Multi-Tooth Grinding Jobs, Norton resinoid bonded wheels hold size so that each tooth gets uniform grinding. The straight, thin shapes make excellent cut-off wheels for salvaging damaged carbide tools.

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PREVIEWS

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TOOLING and PRODUCTION'S Inform-A-Gram Section is a CARDload of Information

341 Items are covered in Condensed Catalog No. 22 offered by the Northwestern Tool & Engineering Co., 116 Hollier Ave., Dayton 3, Ohio. Dimensions, prices, and other pertinent information are included. Some of the products covered are step clamps, T-nut and stud sets, plain clamps, punch press sets, step block sets, and fixture keys.
Circle Inform-A-Gram No. B7.

3-1 Hand Tachometers which dependably measure the speeds of rotating parts and moving surfaces are illustrated and described in Bulletin 103 available from the Metron Instrument Co., 432 Lincoln St., Denver 3, Colo. The 3 in 1 has three separate ranges in one instrument. Only one range appears at a time, therefore minimizing reading errors.
Circle Inform-A-Gram No. B8.

Norton wheel

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Diamond wheels in carbide grinding more than pay for themselves. "It's just like finding money."

You can cut grinding time — and grinding costs — to the lowest possible by standardizing on Norton diamond wheels.

As a result of Norton Company's long pioneering† in diamond wheel development, Norton diamond wheels bring you a combination of long service life and efficient cutting action that means maximum economy — across the entire range of carbide grinding applications.

Besides the vitrified and resinoid bonded types shown here, Norton diamond wheels are also available in a metal bond — where durability and resistance to grooving, rather than a fast rate of cut, are primary considerations. For every application the proper size and type of Norton wheels are available in a wide variety of grit sizes. (*For small-volume requirements, Norton K Bond* CRYSTOLON *wheels are often the best investment. See small illustration.*)

See Your Norton Distributor

for aid in selecting the right Norton wheels for every grinding job. And ask him for the 142-page, illustrated booklet: "Grinding Carbide Tools." Or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities. Listed under "Grinding Wheels" in your classified phone directory. *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Mass.

Norton K Bond CRYSTOLON* Wheels

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W-1580

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†First with resinoid bonded, first with metal bonded, first with vitrified bonded diamond wheels.

CIRCLE INFORM-A-GRAM KEY NO. 1261

Straight Side Single Crank Presses are described and pictured in a new, 20-page two-color catalog just issued by the E. W. Bliss Co., Canton, Ohio. Identified as S-1 presses and incorporating J.I.C. specifications, the machines include such features as heavy box-type crowns and motorized slide adjustments. The new brochure (Catalog 9-D) illustrates various models with capacities ranging from 50 to 400 tons. It lists detailed specifications and dimensions and also describes several types of Bliss clutches.
Circle Inform-A-Gram No. B9.

A New 340-Page Standard Products Catalog 950, providing easy and rapid selection has just been published by the Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. The products shown fall into several

major classifications. Those include chains and sprockets for conveying, elevating and power transmission. Tables of pre-engineered drives facilitate the selection of standard roller chain drives and silent chain drives. Complete listings are given of stock and made-to-order chains and sprockets.
Circle Inform-A-Gram No. B10.

Hand Broaching Machine. The new low price Pioneer Model VH-215 hand broaching machine is completely pictured and described in a new folder which presents the many features of this unit. The publication also shows the type of broach cuts which can be made and pictorially points out and describes the simplified, advantageous method of handling vertical pull broaching on the machine. Copies of the folder can be obtained from the Pioneer Broach Co., 6434 E. Telegraph Rd., Los Angeles 22, Calif.
Circle Inform-A-Gram No. B11.

Control Valves. Features of Ross air valves, their advantages, working principles and models available are discussed in an illustrated brochure (Bulletin 101B) being offered by the Ross Operating Valve Co., 120 E. Golden Gate Ave., Detroit 3, Mich. **Circle Inform-A-Gram No. B12.**

Machining Steel Bars. A fast cutting steel is described in a new bulletin that gives chemical composition, mechanical properties, and case studies. The bulletin (11-1) is published by Joseph T. Ryerson & Son, Inc., Box 8000-A Chicago 80, Ill. **Circle Inform-A-Gram No. B13.**

Split Ball Bearings are covered in Catalog No. 54 available from the Split Ballbearing Corp., Lebanon, N. H. The booklet contains load and speed ratings, design data, dimensions, etc. The types shown are single and double row ball bearing bushings in extra-thin sections; fully split heavy duty pillow blocks; fully split, heavy duty ball and roller bearings; and thin section instrument bearings in torque tube dimensions for precision applications. Information on the various design features possible by fractured race bearings is also included. **Circle Inform-A-Gram No. B14.**

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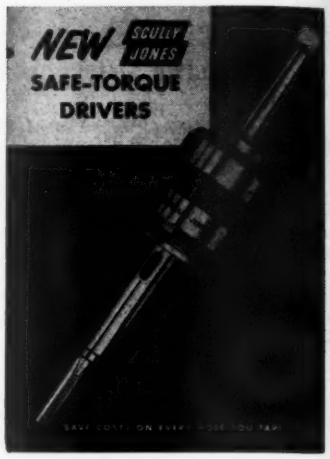


Safe-Torque Drivers. This is a new bulletin (No. 20-50) available from Scully-Jones & Co., 1901 S. Rockwell St., Chicago, Ill. It covers construction features and specifications of the company's releasing, adjustable torque drivers for taps. **Circle Inform-A-Gram No. B15.**

Spherical Washers made of powdered metal are now being offered in a wide range of sizes by Lodding, Inc. Dept. N82, 79 Beacon St., Worcester 1, Mass. Complete details, as well as a catalog of the Lodding line, complete with full-scale layouts of every fixture, are available. **Circle Inform-A-Gram No. B16.**

A Hydraulic Grinder Catalog describing the Model 1024 internal and universal hydraulic grinder has been prepared by Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass. Featured in this booklet (Catalog 1024B) is the double-end wheelhead, which swings 180° for internal and external grinding. **Circle Inform-A-Gram No. B17.**

Design & Performance Characteristics of its line of "DO" (diaphragm operated) solenoid valves are contained in Bulletin M-500 offered by the Eclipse Fuel Engineering Co., Rockford, Ill. The bulletin includes photographs, line drawings, specifications and tables. **Circle Inform-A-Gram No. B18.**

Taper-Boring Head. The Model "D" Universal taper-boring head made by the John Kis Mfg. Co., Racine, Wis., may be readily adapted to a jig borer, milling machine, or a horizontal boring bar with a simple tapered or flanged type adapter. The device may be used for taper boring, taper turning, back facing, bevelling, grooving, straight boring and counter boring. Literature describing the taper-boring head is available. **Circle Inform-A-Gram No. B19.**

Specialized Processing Carriers are the subject of a catalog recently issued by Wiretex Mfg. Co., Inc., 40 Mason St., Fairfield, Conn. The catalog illustrates the wide variety of wire mesh products made by the firm in every size, mesh, and alloy. Included in the catalog are sections on baskets, processing and heat treating equipment, fixtures and crates, tanks, plating, and special equipment.
Circle Inform-A-Gram No. B20.

Centerless Grinding Wheels. Manhattan Rubber-Bonded centerless grinding wheels are described in Bulletin No. 6925 being distributed by the Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J. Examples are given to show that with Manhattan wheels fewer passes are required to obtain the desired finish. Information on regulating or feed wheels is included, and a page is devoted to a simplified price list.
Circle Inform-A-Gram No. B21.

Underdrive Squaring Shears. Comprehensive, new Bulletin 69D, just published by Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y., contains latest information on the entire line of Niagara underdrive power squaring shears. Described fully are the multiple-point sleeve clutch, self-compensating holddown, self-measuring back gage, enclosed drive, four cutting edge knives, optional accessories and extra equipment.
Circle Inform-A-Gram No. B22.

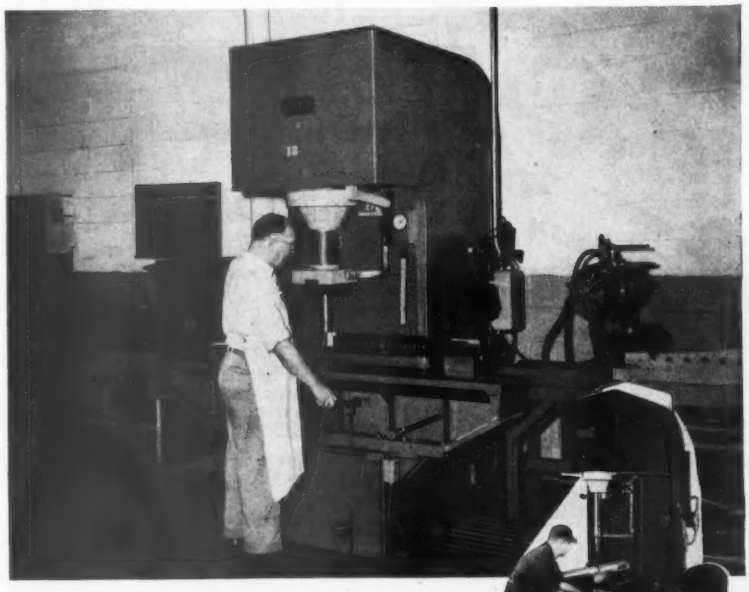
Trace-O-Matic Bulletin. This new bulletin describes the Axelson Trace-O-Matic hydraulic tracer attachment that may be applied to Axelson heavy duty lathes for duplicating turned parts from inexpensive flat templates. The bulletin includes information regarding setup,

how to make the plates, and two pages of case histories showing the high production performance that can be obtained with Axelson lathes equipped with the Trace-O-Matic attachment. Write to Axelson Manufacturing Co., 6160 S. Boyle Ave., Los Angeles 58.
Circle Inform-A-Gram No. B23.

Variable Speed Band Sawing Machines with hydraulic tables are the subject of an illustrated brochure (circular No. 100) being distributed by The Tannewitz Works, Grand Rapids, Mich.
Circle Inform-A-Gram No. B24.

Induction Heating Equipment. The newly developed Kilotron, a high frequency (400-kilocycle) induction heater, is the subject of a brochure offered by Electric Arc, Inc., 152 Jelliff Ave., Newark 8, N. J. Included in the coverage is a discussion of the range of production line application of this relatively new and advanced technique. The description takes in both the 10-kw and the 20-kw models.
Circle Inform-A-Gram No. B25.

Extra Services to users of cold finished steel is offered with the new J & L controlled atmosphere furnace. Steel processed in this furnace is enveloped in a controlled oxygen-free gas atmosphere as compared to an atmosphere of air in conventional furnaces. A booklet explaining all is available from the Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa.
Circle Inform-A-Gram No. B26.



Dake Gap Type Press broaches boring bars

How to Straighten Flap Tracks

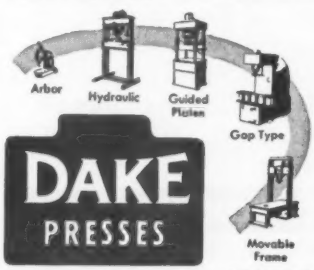
Precision parts for aircraft call for the use of precision equipment.

These flap tracks, machined from 4130 steel (aircraft quality), must be checked on a straightening press four times during fabrication. For ease of control and accuracy, the work is done on Dake Gap Type Presses like that shown in the photograph above.

To the right of the ram, the operator has placed a rule gauge which indicates ram travel. Knowing the elasticity of the piece being tested, he can estimate the overtravel necessary to straighten the piece with a single movement of the ram.

Dake Gap Type Presses are available for straightening or forcing, in 22 models ranging up to 300 tons capacity. They are fully described in Bulletin No. 299—sent on request.

Dake Engine Company, 634 Seventh St., Grand Haven, Mich.



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CIRCLE INFORM-A-GRAM KEY NO. 1291

A New Profilometer Tracer with a long beam can measure the roughness of small holes, narrow slots, and small parts. Full details and specifications are given in Bulletin LT95, available from the Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor, Mich.
Circle Inform-A-Gram No. B27.

A New Power Chuck Fixture developed by The Skinner Chuck Co., New Britain, Conn., is illustrated and described in Bulletin PCF67 offered by the firm. The unit discussed is a non-rotating, air operated, work holding fixture for use on drilling and milling machines, for assembly operations, and for other bench and machine installations.
Circle Inform-A-Gram No. B28.

The Unique Features of the new Swiss form grinding machine "Copyrex" are illustrated and described in a bulletin available from the High Precision Products Co., Westfield, N. J. Features of the machine include the grinding of irregular forms by means of the pantograph, and a generating motion of the head to produce two form tools in the same motion that usually produces only one. **Inform-A-Gram No. B29.**

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CIRCLE INFORM-A-GRAM KEY NO. 1301

Centerless Grinders. A new bulletin (CT-54) describing its two models of precision centerless grinders has been issued by the Landis Tool Co., Waynesboro, Pa. This bulletin points up special operating features, lists standard equipment, and gives specifications.
Circle Inform-A-Gram No. B30.

Hydraulic Presses are the subject of Catalog No. 54 offered by the Greenerd Arbor Press Co., 41 Crown St., Nashua, N. H. The presses described range in capacity from 1 1/2-ton bench type models to 70-ton 4-posted types. Illustrations and specifications are included.
Circle Inform-A-Gram No. B31.

"Engineering Audit of Facilities and Organization" is the title of a new brochure offered by Anderson-Nichols & Co., 150 Causeway St., Boston, Mass. The booklet describes a program for obtaining balance and harmony between all phases of company operations. It covers the scope and objectives of such an audit.
Circle Inform-A-Gram No. B32.

Deforming is a simple, fast and inexpensive procedure to form-true grinding wheel contours accurately — and guarantee repeat truings of these contours to the same degree of accuracy as often as required, eliminating costly, time-consuming "cut and try" methods. A comprehensive bulletin describing the Series "R" Diaform wheel forming attachment for cutter relief angle compensation is available from Pratt & Whitney Division of Niles-Bement-Pond Co., West Hartford, Conn.
Circle Inform-A-Gram No. B33.

Plating Automation as a revolutionary concept is presented in the description of the fully automatic plating machine contained in Bulletin B 50-54. The literature (available from the Automatic Plating Division, Wagner Brothers, Inc., 400 Midland Ave., Detroit 3, Michigan) gives a comprehensive explanation of the unique parts transfer and conveying principle of the machine.
Circle Inform-A-Gram No. B34.

The Nutmeg Sheet Steel Separator is a permanent magnet self contained device which requires no electrical or air connections. Complete details on this unit are available from the Durant Tool Supply Co., 136 S. Water St., Providence 3, R. I.
Circle Inform-A-Gram No. B35.

A New Line of 4-Way Valves (designated as the MV Series) for air or hydraulic service to 200 psi is now in production by the Modernair Corp,. 400 Preda St., San Leandro, Calif. Literature containing specifications, applications data and prices may be obtained.
Circle Inform-A-Gram No. B36.

Shear-Speed Bulletin. Ready for distribution is Bulletin No. 1800-54 summarizing the Shear-Speed shaper line of the Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. This literature outlines in detail the Shear-Speed process for cutting gears, splines, cams, sprockets, and miscellaneous external shapes, one or several at a time.
Circle Inform-A-Gram No. B37.

A New Engineering Memorandum containing useful information on Ledloy-A, the free machining, lead bearing steel, which machines and spreads faster than those used for common screw stocks, is available from Peter A. Frasse & Co., Inc., 17 Grand St., New York 13, N. Y. The memorandum (No. 12) includes such data as analysis comparison, typical mechanical properties and machining comparisons.
Circle Inform-A-Gram No. B38.

"Flying M" Etched Circuits eliminate hand wiring by etching the desired pattern on a metal-clad laminate. In many cases electronics and electrical manufacturers have found that this method of reproducing circuits results in a saving on labor cost of up to 50%. A descriptive folder on the circuits is available from the Miller Dial & Name Plate Co., 4400 North Temple City Blvd., El Monte, Calif.
Circle Inform-A-Gram No. B39.

Apex Magnetic Screwdriving and nut-running bits and tools are illustrated and described in the 56-page Catalog 21 offered by The Apex Machine & Tool Co., 1068 S. Patterson Blvd., Dayton 2, Ohio. The catalog lists many bit holders and insert bits, power bits, hand drivers, and finder sleeve assemblies. Included in the listings are specifications, sizes and applications.
Circle Inform-A-Gram No. B40.

A Turret Stop Indicator of unique design is illustrated and described in literature available from the D-S-C Machine Co., 29 Bertel Rd., Mt. Vernon, N. Y. The indicator was developed as an aid in the duplication of machined parts. It maintains length tolerances and eliminates the possibility of operator error. The dial indicator has a range of 0.150" and is graduated 0.001".
Circle Inform-A-Gram No. B41.

The New Design of the Reeves Fractional HP Vari-Speed Motodrive is completely described in Catalog M-543 which is now available. The booklet, in addition to outlining all of the operating features, gives list prices for all units, controls, and modifications. The unit comes in ¼, ⅓, ½, and ¾ hp capacities in speed ratios of 2:1 through 10:1. The catalog is offered by the Reeves Pulley Company, Columbus, Ind.
Circle Inform-A-Gram No. B42.

Balancing Rotating Parts easier, faster, and more accurately are discussed in an illustrated brochure available from the Anderson Bros. Mfg. Co., Rockford, Ill. Specifications are included in the literature.
Circle Inform-A-Gram No. B43.

Precision Diamond Compound literature is available from the Precision Supply & Machine Co., 12-36 River Rd., Fair Lawn, N. J. The booklet includes a specification chart and price list of compounds for various polishing, lapping, and cutting applications.
Circle Inform-A-Gram No. B44.

Coolant Systems are the subject of a publication now being offered by Easy Industries, 162 N. Clinton St., Chicago 6, Ill. Included in the literature is a coolant recommendation guidance table.
Circle Inform-A-Gram No. B45.

Lathe Chucks. The Westcott line of special handwheel actuated glass-working lathe chucks are illustrated and described in the new WGL-100 folder being offered by the Westcott Chuck Co., Oneida, N. Y. The literature includes complete specifications and dimensions.
Circle Inform-A-Gram No. B46.

Believing that there is too great a void between standard and special tooling, Mohawk has designed and developed a semi-standard subland tool.

The Mohawk Size-Optional Subland is machined, hardened and placed in a stock bin. This results in a material saving to the customer in set-up costs, reduces delivery time to a fraction of that usually required for special tools, and allows a tremendous reduction in inventory. In ordering these Size-Optional Sublands, the customer is limited only in relation to shank specifications, and partially on overall length requirements. Diameters and step lengths are completely optional to fit the particular application. Write for full details.

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CIRCLE INFORM-A-GRAM KEY NO. 1311

Universal Drilling Machines. A descriptive bulletin covering the purpose and specifications of its new universal drilling machine has just been issued by the Hartford Special Machinery Co., Hartford 12, Conn.
Circle Inform-A-Gram No. B47.

Rust Removal. A completely new, non-acid rust removing material that simultaneously strips paint, rust and primer from ferrous metal surfaces has been developed. An illustrated brochure describing this method is available from Turco Products, Inc., 6135 S. Central Ave., Los Angeles 1.
Circle Inform-A-Gram No. B48.

Qualified Center Lapping Machine features are illustrated and described in Catalog 54 now available from the Qualified Gage Co., Berkley, Mich. Some of the features discussed are the spring cushion tailstock that prevents lapping stone breaking, loading, or burning; positive dressing form from lifetime cam.
Circle Inform-A-Gram No. B49.

The New 16" 'LA' Engine Lathe recently announced by the Nebel Machine Tool Co., Cincinnati 25, Ohio, described in literature now available.
Circle Inform-A-Gram No. B50.

Now—Lock Your Feed Rates to Protect Machines . . . Reduce Costs with the CROSS Flow Control Lock!

Only authorized personnel carry a key for the Cross Flow Control Lock! They set machine feed rate, then lock it.

Easy to install. Just remove valve nameplate and adjusting lever, reinstall over lock mounting plate.

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- Reduces Maintenance Costs

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DETROIT 7, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 1321

Thread Comparator. For gaging external threads faster, more dependably, and at lower cost P & W introduces its new precision Tri-Roll thread comparator. Complete data on this versatile instrument is available by writing to Pratt & Whitney, Division Niles-Bement-Pond Co., West Hartford 1, Conn., for Circular No. 570, or—
Circle Inform-A-Gram No. B51.

A 30" Projection Type Rotary Table (Model O-R-T800) with full optical setting from master glass dial and grid screen reading is illustrated and described in a bulletin available from George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y. Grid screen provides instantaneous reading in degrees, minutes, and seconds without further manipulation.
Circle Inform-A-Gram No. B52.

Storage & Materials Handling. A folder graphically showing the "Stackbin System" of storage and materials handling is available from the Stackbin Corp., 1273 Main St., Pawtucket, R. I. The booklet relates how this system is used throughout industry to cut handling costs, save space, improve inventory control, minimize loss and damage.
Circle Inform-A-Gram No. B53.

Hand Threading Stainless Steel Tubular Products. A folder of interest and value to those confronted with the task of hand threading stainless steel pipe has recently been published by the Tubular Products Division of The Babcock & Wilcox Co., Beaver Falls, Pa. The booklet (TDC 147) discusses die stock, dies, speeds, cutting oils, and the assembly of threaded joints.
Circle Inform-A-Gram No. B54.

Thermostat Metal. A bulletin describing the new ASC-1 thermostat metal strip as well as fabricated bimetal elements for use in the automotive, electrical, heating, appliance, instrument, and control fields, is being offered by the Thermostat Metal Division, American Silver Co., Inc., 3607 Prince St., Flushing 54, N. Y. Tables, charts and formulas are included to assist the user in the design of thermostat metal elements.
Circle Inform-A-Gram No. B55.

What You Should Know about surface broaching to gain the full benefits of its possibilities is just a little of the information contained in the new, enlarged and more profusely illustrated Duplex Vertical Hydro-Broach Machine Catalog No. M-1848. Highlights of design, applications and specifications of the Duplex vertical machine are also presented in this brochure offered by The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.
Circle Inform-A-Gram No. B56.

Detailed Information covering the complete new line of Niagara straight side double crank presses has just been published in Bulletin 64-H by Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.
Circle Inform-A-Gram No. B57.

CYW Choice Hot Work Steel is described in detail in Catalog Section 10-280, just released by Firth Sterling, Inc., 3113 Forbes St., Pittsburgh 30, Pa. The literature contains type analysis, characteristics, applications, general heat treatment, and forging and annealing features.
Circle Inform-A-Gram No. B58.

Gears, Sprockets, Shafts, Bronze Castings and similar parts made to customer specifications are featured in a new brochure published by the Penn Machine Co., Johnstown, Pa. The brochure also includes details on the company's planning procedures, engineering facilities, and testing and inspection processes.
Circle Inform-A-Gram No. B59.

Power Spray Washers. Technical Bulletin No. 301 on power spray washers is now available from Peters-Dalton, Inc., 17900 Ryan Rd., Detroit 12, Mich. This profusely illustrated brochure groups and discusses in a clear and comprehensive manner all types of power spray washers, their layouts, and applications. Fifteen engineering drawings, incorporating the essential features of a number of most commonly used types of washers, are included.
Circle Inform-A-Gram No. B60.

Adjustable Ball-Bearing Centers. Bulletin CS-50 illustrates and describes the new "Mac" Model HDR and HDT heavy-duty revolving centers and Model RS self-locating revolving stops for lathes, turret lathes, automatic screw machines and grinders. Included is a full explanation of the exclusive 3-point "Swirling bearing" principle and the stabilizer bearing feature which aid in attaining perfect work alignment for precision machining within 0.0001 concentricity. The booklet is available from The Whitfield Mfg. Co., 400 Oakland Ave., Washington Court House, Ohio.
Circle Inform-A-Gram No. B61.

Design Features, operating instructions, and maintenance information on an automatic dial feed multiple-spindle machine are included in the "Bodine 40-10 Catalog" offered by the Bodine Corp., Bridgeport 5, Conn. The basic design of this machine allows easy adjustment or conversion of spindles and other mechanisms for the processing of a variety of parts on the same machine. Isometric, exploded, and silhouette drawings quickly identify and illustrate both operation and parts.
Circle Inform-A-Gram No. B62.

An Idea Book. Here is a booklet presented, according to its publisher, the Gast Mfg. Corp., Benton Harbor, Mich., as an idea-source. On its pages, you'll see brief stories about a variety of products—most of them from totally unrelated fields. On each product, air is applied to a new job—or to do an old job better.
Circle Inform-A-Gram No. B63.

Power with the light-fingered touch—for those hard-to-get-at places! Haskins Flexible Shaft Equipment lets the power do the job without burdening skilled hands with heavy motors. For every job of grinding, sanding, filing, polishing or buffing—from ¼ HP to 2 HP—Haskins tools increase production and cut costs. Two good reasons why you should write for the latest Haskins Catalog.

The Haskins line provides a wide variety of models with drives, horsepowers, speeds, tools and attachments—including the one assembly exactly suited for your particular job.

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CIRCLE INFORM-A-GRAM KEY NO. 1331

Burners and Furnaces for hardening, tempering, and annealing, valves; torches; mixers; blowers; and water warmers are described in this new bulletin (No. 55) just issued by the Johnson Gas Appliance Co., Cedar Rapids, Iowa.
Circle Inform-A-Gram No. B64.

The New Series 24 Automatic Drill Unit manufactured by Dumore is described and illustrated in a bulletin now available. The publication gives specification details on the unit relating to physical dimensions, motor control, capacity and lubrication. The new unit as described in the booklet, has all necessary circuits built in and features simple mounting procedures, controlled feed, and resistance drilling. Copies of the booklet may be obtained by writing to Department 24, Dumore Co., 1300 17th St., Racine, Wis., or—
Circle Inform-A-Gram No. B65.

The New 12-Pointer Nut for use in mating with the 12 lands in double hexagon sockets (thus, distributing the driving loads so that thin wall socket wrenches of smaller O.D. can be used without breaking), is illustrated and described in a bulletin now available from the National Machine Products Co., 44225 Utica Rd., Utica, Mich.
Circle Inform-A-Gram No. B66.

Industrial Drill & Tap Chucks. "If it's a Jacobs—it holds!" is the motto of The Jacobs Mfg. Co., West Hartford 10, Conn. And a brand new catalog (No. 100) now available from this firm will hold your attention for some time. This comprehensive publication contains the following: Service and repair of chuck; data on plain bearing key type chucks; parts for plain bearing chucks; arbors and adapters, etc.
Circle Inform-A-Gram No. B67.

In-Line Valves. A new line of in-line valves designed for increased operating efficiency, greater flexibility, and easier maintenance through extreme simplicity of design and maximum interchangeability of parts, has been developed by Numatics Operating Valve, South Main St., Milford, Mich. Bulletin No. 4020, containing complete details, is available.
Circle Inform-A-Gram No. B68.

Products & Services of ABA Tool & Die Co., Inc., Manchester, Conn., are illustrated and described in a booklet now available. The publication depicts a selection of the molds, tools dies, and machined parts made by the company for the plastics, metal working and allied industries. The booklet covers products ranging from injection molds and parts for the electronic industry to experimental and production parts for the aviation field.
Circle Inform-A-Gram No. B69.

Office-Size Whiteprinter. A new, complete bulletin (54C5) describing an advanced design office-size Copymaster Whiteprinter is now available from the Peck & Harvey Sales Corp., 5640 N. Western Avenue, Chicago 45, Ill. The bulletin tells how Copymaster efficiently and economically produces black line and colored line ammonia-dry whiteprint — continuously or intermittently—in office plant or laboratory at low cost.
Circle Inform-A-Gram No. B70.

For Years, Milne Has Been Delivering Hollow Die Answers* To Tooling Problems..
*All are Genuine Tool Steels
GRAPHITIC
HOLLOW DIE STEEL
Widest Range Of Applications Including forming, drawing, sizing, flanging, embossing, and combination dies, work support blades, forming rolls, steel mill straightening rolls, machine parts, plug, thread and ring gauges, cams, bushings, sleeves, mandrels, fixtures and other applications.
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MILNE
has the answer to a diemaker's dream!
• MINIMIZES MACHINING
• CUTS WASTE
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JIC-06 . . . Oil Hardening, Non-Deforming . . . Full Length Kolorkoted Pink and Gray for Permanent Identification
This new combination of Timken® Graphitic Steel features in Hollow Die (Tubular Tool) form is Milne's latest bee-line to better, lower-cost tooling.
Has a double advantage over standard oil hardening tool steels.
1. Free graphite makes it the fastest, easiest machining tool steel in tubular form and insures non-seizing properties.
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Rough turned O.D. and I.D. Saw cut faces. Furnace annealed — no scale. Cut to any length.
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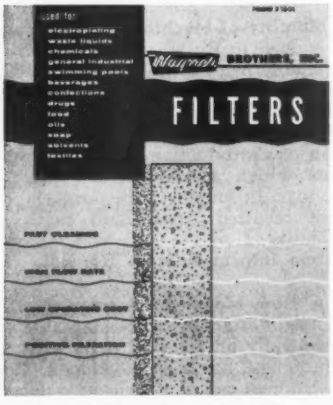
American-Canadian Tool Steel Specialists
Complete Line Of Tool Steels—Hollow and Solid
Complete line of tool steels . . . Wide range of grades and sizes.
CIRCLE INFORM-A-GRAM KEY NO. 1341

Electronic Trouble Shooter. An instrument that provides quick and accurate answers to problems of manufacturing, inspection, maintenance, and service is the subject of Bulletin 3059-1 available from Erwood, Inc., 1770 W. Berteau, Chicago 13, Ill. The trouble shooting unit is a machine that accurately locates, analyzes, and compares vibrations and noises in mechanical devices. It reports findings back to you via a calibrated noise meter dial and thru a 4" amplifying speaker or head phones.
Circle Inform-A-Gram No. B71.

The Latest Pull-Down Broaching Machines designed by Colonial Broach Co., P. O. Box 37, Harper Station, Detroit 13, Mich., are treated in detail in a new bulletin (RD-54). Tabulated in a very complete form is the specification data on nine different machine models including an entirely new 50-ton, 72" stroke machine. Also presented in table form with an accompanying keyed line drawing are significant dimensions of each model.
Circle Inform-A-Gram No. B72.

Index of Literature. Bulletin 100-C available from the Minneapolis-Honeywell Regulator Co., Industrial Division Wayne & Windrim Aves., Philadelphia 44, Pa., lists all current Honeywell Industrial Division literature. Numbers and titles of all catalogs, bulletins, specification sheets, and instrumentation data sheets are included.
Circle Inform-A-Gram No. B73.

Liquid Filters. A new illustrated folder, describing Wagner Brothers' line of permanent membrane type liquid filters, is now available. The literature explains precoating, filtering, and cleaning operations, with schematic drawings showing flow directions during each of these phases. Secure your copy of Folder F 10-45 by writing to the Filter Division, Wagner Brothers, Inc., 400 Midland Ave., Detroit 3, Mich., or—
Circle Inform-A-Gram No. B74.



Grommet Brochure. Listed and illustrated in the pages of a new brochure available from Goshen Rubber Co., Inc., Goshen, Ind., are the many sizes and types of quality grommets available from this firm.
Circle Inform-A-Gram No. B75.

Threading Heads. The Solid Adjustable Threading Heads Bulletin F-78-3 in its revised edition is now available from the Landis Machine Co., Waynesboro, Pa. The literature includes detailed data on all Landis solid adjustable heads, which feature tangential chasers and cover a pipe range from ⅛" to 6".
Circle Inform-A-Gram No. B76.

Booster & Accumulators for fluid power applications are illustrated and described in Catalog B-54 offered by the Petch Mfg. Co., Alpena, Mich. Included in the literature is complete engineering data.
Circle Inform-A-Gram No. B77.

Two-In-One Hydraulic Press. Now on the market is a combination hydraulic forcing and straightening press. A specification manual describing this two-in-one press completely is available from the Stanley H. Holmes Co., 3300 W. Lake St., Chicago 24, Ill.
Circle Inform-A-Gram No. B78.

RO LEAVES METAL BEHIND THE EDGE - MAKES TOOLS LAST LONGER!

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RADIAL RELIEF ONLY
AXIAL RELIEF ONLY
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Increased life, better performance for practically all end and side cutting tools is now possible. New design gives traverse, not rocking, action with tool remaining on wheel center. Set-up so fast and simple you can standardize on this better grind for tools of 1 to 16 flutes. Easy cam interchange – selective degree of relief without changing cams.

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ROYAL OAK, MICH.

CIRCLE INFORM-A-GRAM KEY NO. 1351

The Sciaky Dial Feed, a universal, rotary indexing unit for all applications on resistance welders, machine tools, and various assembly operations, is described in Bulletin No. 319-12 available from Sciaky Bros., Inc., 4915 W. 67th St., Chicago, Ill.
Circle Inform-A-Gram No. B79.

For Measuring Smoothness or Roughness of polished, lapped, and ground surfaces of any material, an interference microscope has been developed by Farrand Optical Co., Inc., Bronx Blvd. & E. 238th St., New York 70, N. Y. This is a high-power, high-resolution, and versatile optical instrument adaptable for either visual or photographic work. Bulletin No. 818, describing two models is available upon request.
Circle Inform-A-Gram No. B80.

Slide Honing, the modern precision tumbling process, is described in a booklet offered by the BMT Mfg. Corp., Elmira Heights, N. Y. Metals, plastics, castings, and parts of all kinds previously considered impractical to finish in tumbling machines are now successfully handled by the BMT Multi-Barrel Slide Honing machine.
Circle Inform-A-Gram No. B81.

Directly Produces Quality Control Charts!

Here, a recorder is used with a Cleveland Par-Ac electronic production gage to make quality control charts for precision machining operations. The gage head is set with a master; and sample parts, taken from the machines at fixed intervals, are quickly checked as shown. The recorder chart shows deviations from nominal size — thus directly provides the data needed for statistical quality control.

Recorders are also used with our Indi-Ac electronic indicator and Micro-Ac electronic microcomparator — to provide chart records of runout, taper, eccentricity, deviations in dimensions, and similar measurements.

FREE BULLETIN 542 shows shop, tool room and gage room applications of this and many other kinds . . . describes the equipment, both standard and special . . . and explains advantages offered only by Cleveland gaging equipment. May we send you a copy?

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CIRCLE INFORM-A-GRAM KEY NO. 1361

Contract Service. "Serving Manufacturing For Half a Century with Complete Sub-Contract Service." is the title of an interesting brochure just issued by the Bridgewater Machine Co., Akron, Ohio. Fully illustrated, the booklet shows many of the firms specialized machine tools in operation, as well as some of the parts, assemblies and complete machines regularly produced.
Circle Inform-A-Gram No. B82.

Utility Drills. Chicago-Latrobe's high speed utility drills are especially designed and heat treated for applications requiring sturdier, shorter drills than are available in the conventional jobbers or wire gage drills because of their heavier construction. An illustrated booklet describing these drills is available from Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Circle Inform-A-Gram No. B83.

Selenifiers and Controls for the electro-plating and metal finishing industries are described in Catalog No. 441 now available from the American Rectifier Corp., 95 Lafayette St., New York 13, N. Y. Complete with illustrations of bench type and floor model selenifiers, the booklet supplies technical data and ratings on every type available in these two general classes of rectifiers.
Circle Inform-A-Gram No. B84.

Drill Unit. A new drill unit incorporating a direct drive electric motor for spindle drive, and ideally suited for single spindle speed high production operations, has been developed by Hause Engineering, Montpelier, Ohio. If you would like to know the basic operational and dimensional characteristics of this unit, Hause Engineering will gladly send you Specification Sheet SS 24-1.
Circle Inform-A-Gram No. B85.

Mobility-of-Machine Benefits are described in Bulletin R541, which is available from the Barry Corp., 1000 Pleasant St., Watertown, Mass. The illustrated booklet gives the results of a timed test involving the relocation of a production line in 23 minutes which served to demonstrate savings in money, time and labor that resulted from plant machine mobility.
Circle Inform-A-Gram No. B86.

A New Model Loadmeter (Model L-122), designed to be adaptable to practically all types of motor driven equipment, has been developed. This instrument can now be used to detect any condition of "overload," and is read by means of a zoned meter. A booklet giving full details is available from the Detroit Milling Cutter Co., 28625 Grand River, Farmington, Mich.
Circle Inform-A-Gram No. B87.

"Resistance Welding at Work", is the title of a new booklet that covers a case history of Sciaky electric resistance welding equipment as used at the Moloney Electric Co. of St. Louis, Mo., one of the largest manufacturers of transformers in the world. Fine examples of electric resistance welding as well as interesting techniques of spot, seam, and projection welding are described. To receive your copy of Vol. 3, No. 7, "Resistance Welding at Work" write to Sciaky Bros., Inc., 4915 W. 67th St., Chicago, Ill., or—
Circle Inform-A-Gram No. B88.

Shaft Couplings. A catalog-specification bulletin completely illustrating and describing Brown Kushion-Torq shaft couplings rated from ¾ to 1500 hp is now available. Data includes list of available sizes with dimensions, weights, and safety factors for use with various types of equipment. Write to the Brown Engineering Co., 23 N. 3rd St., Reading, Pa., for Bulletin 28, or—
Circle Inform-A-Gram No. B89.

Driving Center. A revolutionary new driving center developed by Zee-Hawk Machine Specialties, Inc., 3716 W. Montrose, Ave., Chicago 18, Ill., eliminates whip, vibration, chatter and accidents caused by driving dogs; reduces operator fatigue; machine need not be stopped between workpieces; entire length of workpiece can be machined in one pass; and center is dynamically balanced, hardened, and ground—maximum cut run-out is 0.0002". Bulletin No. 1162-A is available.
Circle Inform-A-Gram No. B90.

A Significant Change is taking place in the pattern of modern industry. Instruments that were formerly restricted to research laboratories are now being integrated into production testing, monitoring and control phases of industry. Quantity production of these instruments is described in a booklet available from the Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.
Circle Inform-A-Gram No. B91.

Carbide Tools & Tool Accessories produced by the Wesson Co., 1220 Woodward Hts. Blvd., Ferndale 20, Mich., are covered in General Catalog 541 now available from the firm. Described in the illustrated 121-page booklet are Wessonmetal carbides, standard flat tools, milling cutters, arbors and parts, reamers, Multicut band type holders, Huski-Cut tool holders, Dual-Wedg lock, universal vises, and angle plates.
Circle Inform-A-Gram No. B92.

"Size-Optional" Brochure. A new circular, describing semi-standard Mohawk size-optional Subland drills, is now ready for distribution. The size-optional feature is a new concept in Sublands in that nearly completed blanks are kept in stock at Mohawk. This greatly reduces delivery time, cuts quantity costs, and allows the customer to greatly reduce inventory. The brochure is available from Mohawk Tools, Inc., 910 E. Main St., Montpelier, Ohio.
Circle Inform-A-Gram No. B93.

A Mechanical Eye to watch your tools is the Cross tool control unit with "Toolometer." The unit provides a continuous picture of the used and unused portions of tool life and makes tool changing and sharpening a scheduled operation. Complete details are contained in an illustrated bulletin (Form No. 642) now being offered by The Cross Co., 3552 Bellevue Ave., Detroit 7, Mich.
Circle Inform-A-Gram No. B94.

The New Shear-Carb shell mills and end mills may be the answer to your milling problems. At any rate, check these new products featuring full flute-length carbide tips with true helix, as described in the latest Shear-Carb bulletin offered by the Wendt-Sonis Co., Tenth & Collier St., Hannibal, Mo.
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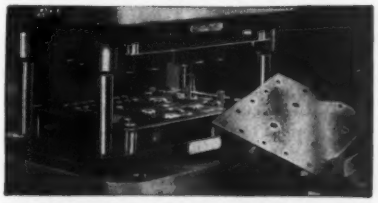

Here are the complete details with prices and application illustrations. Send for these catalogs. No obligation.

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DEMONSTRATION DAILY — BOOTH 135 — METAL SHOW, NOV. 1 TO 5

CIRCLE INFORM-A-GRAM KEY NO. 1371

Lathe Attachments & Accessories are the subject of Catalog 5418 just issued by South Bend Lathe Works, 425 E. Madison St., South Bend 22, Ind. The 40-page brochure is a ready source of features, specifications, and construction data on the complete line of South Bend machine tool attachments and accessories.
Circle Inform-A-Gram No. B96.

Taps Ground From The Solid. The Jarvis High Speed Tap Manual and Catalog has been designed to do a threefold job. First it contains a complete description of Jarvis facilities, which reflect new methods and techniques; second, it presents the latest reference material available on the uses, types and performances of industrial taps; and third it lists and illustrates the entire range of Jarvis taps. For your copy of Catalog No. T-54, write to The Charles L. Jarvis Co., Middletown, Conn.
Circle Inform-A-Gram No. B97.

Eight New Hydraulic Control Valves with ball detent for position locking have been announced by the Logansport Machine Co., Inc., Logansport, Ind. Included are six 3-position, 4-way valves and two 2-position, 4-way and 3-way valves. Catalog sheets on these new valves have been incorporated in Logan Catalog No. 200, Section 4, which is available upon request.
Circle Inform-A-Gram No. B98.

Mechanical Power Transmission Products made by the Morse Chain Co., 7601 Central Ave., Detroit 10, Mich., are completely described in a newly revised Catalog B20-53. The publication covers silent chain, roller chain, and Hy-Vo drives; sprockets, cable chains, drive shafts, couplings and clutches.
Circle Inform-A-Gram No. B99.

"Engineered Live Centers" is a new illustrated catalog containing specifications and prices of the standard live centers which are made with Morse taper and also includes three types of specials. The publication has just been released by the Sturdimatic Tool Co., 3900 F St., Detroit, Mich.
Circle Inform-A-Gram No. B100.

Tool Room Accessories and components are illustrated and described in a handy, pocket-sized booklet available from the Reid Tool Supply Co., 332 W. Delano Ave., Muskegon Hts., Mich. Among the accessories covered in this Catalog 154 are tool and die maker's aids, vises, set-up aids, and milling attachments for lathes.
Circle Inform-A-Gram No. B101.

"Compensating Equalizer," used in a vise or as a component part of a jig or fixture, firmly clamps up to 10 parts at one time by automatically compensating for size differences in the parts. The new unit is completely described in Bulletin 1021 which is available upon request from Design Aids Co., 130 N. 7th St., Newark 7, N. J.
Circle Inform-A-Gram No. B102.

Changes In Its Hydraulic Power Unit Model 6031 to provide additional pressure range from 1200 to 2000 psi has been announced by the Logansport Machine Co., Logansport, Ind. This model has previously been offered only in pressures from 250 to 1000 psi. The new Logan Catalog 200, Section 1, now contains this engineering data and is available upon request.
Circle Inform-A-Gram No. B103.

Diamond Grinding Wheels. A new catalog, No. 1233, containing a comprehensive assortment of standard sizes of diamond grinding wheels and hones has just been published by the Norton Co., Worcester, Mass. Included in this 52-page booklet is data on diamond wheel markings, selection of wheels, standard shapes of wheels, and suggestions on the use of diamond wheels and hones.
Circle Inform-A-Gram No. B104.

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CIRCLE INFORM-A-GRAM KEY NO. 1381

34 Practical Production Ideas to help you increase output and reduce costs are contained in a booklet offered to TOOLING & PRODUCTION readers by the Potter & Johnston Co., Newport Ave., Pawtucket, R. I. The literature covers such topics as machining hard-to-handle pieces; machining cut-off bar stock; and machining both ends in a single chucking.
Circle Inform-A-Gram No. B105.

For Safer Punch Press Operation, a Lifeguard valve used with pneumatic clutch and brake "senses" improper valve operation and becomes inoperative at completion of that valve cycle. The valve then will not actuate the press. Bulletin 306, offered by the Ross Operating Valve Co., 120 E. Golden Gate, Detroit 3, Mich., describes this air control device completely.
Circle Inform-A-Gram No. B106.

One-Half Million Stock Parts for press dies are listed in a catalog now available from Toolcraft Industries Corp., 305 E. 140th St., New York. The booklet contains listings of such parts as die bushings; piercing die punches; slug ejector punches; quills; stripper guide bushings; quick change quills; punch holder bushings; high precision lamination perforators; heavy duty punches, dies and guides; and shaped punch quills.
Circle Inform-A-Gram No. B107.

Viking Milling Cutters are designed to fit a wide range of operations on various types of machine tools machining many different materials. Viking's new 44-page general catalog lists standard cutters with either H.S.S. or carbide blades. The booklet, available from The Viking Tool Co., Shelton, Conn., carries data on carbide single point tools with mechanical chip breakers; special milling cutters; and sharpening fixtures and methods.
Circle Inform-A-Gram No. B108.

Protection of Pressure Systems by frangible discs is discussed in a series of catalog sheets available from Frangible Discs, Inc., 57 Railroad Ave., Penns Grove, N. J. A frangible disc is an individually-designed pressure relieving device used to protect equipment or process systems wherever over-pressure is a problem. It consists of a preformed metal rupture disc which is held between specially-machined retainer rings and fits into piping systems between standard pipe flanges.
Circle Inform-A-Gram No. B109.

Heat Treating Pots, Tubs, & Boxes. Bulletin No. 5 on eight types of heat and corrosion resisting cast alloy heat treating pots, tubs, and carburizing boxes has just been released by Standard Alloy Co., Inc., 1679 Collamer Rd., Cleveland 10, Ohio. Complete specifications are given for 17 round pots for salt, cyanide and lead solutions; six rectangular tubs; 31 rectangular carburizing boxes; and 19 round carburizing boxes.
Circle Inform-A-Gram No. B110.

The Air-Hydraulic Press for kick and arbor press operations is described in the 1954 bulletin available from Air-Hydraulics, Inc., 811 Belden St., Jackson. Mich. This press does countless operations in metals, plastics, ceramics, leathers, etc. Also described are air controlled index tables, impact hammers, air-hydraulic accumulators, hammer heads, and other pneumatic devices.
Circle Inform-A-Gram No. B111.

A Portable Hardness Tester for aluminum alloys, copper, brass, and other materials (including plastics) is discussed in the illustrated Bulletin F 1689-2 which can be had from the Barber-Colman Co., 1200 Rock St., Rockford, Ill. The instrument covered is the Barcol Impressor which has been designed for use on fabricated parts and assemblies as well as on raw stock.
Circle Inform-A-Gram No. B112.

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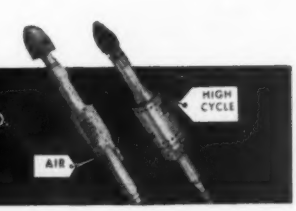

CIRCLE INFORM-A-GRAM KEY NO. 1391

. . . Surface Plate, from page 125

ing number of manufacturing plants that are finding a similar need.

The Company has made special laboratory plates accurate to 0.00001" (ten-millionths), and so accepted by a government agency. Yet the less accurate grade AA commercial surface plate, shown and specified in Figure 4, is at present beyond the requirements of all but a few concerns. However, with ever closer tolerances being required on tools and gages, more and more concerns will be requiring the grade AA.

For the many who do not require such extreme accuracy, our company has a grade A plate on which every 2 ft. square area is accurate to 0.0001". The specifications for a grade A plate 6 ft. long are:

1. All points on the surface shall lie between two parallel planes separated by 0.0006", and

2. All points on the surface of any 2 ft. x 2 ft. area shall lie between two parallel planes separated by 0.0001", and

3. The surface shall be in the form of a segment of a quite uniform convex sphere.

For different surface plate sizes of the same grade the only variation in the 3-point specification is in the over-all value shown in I of Figure 4.

Write Your Own Specification

While the above description has necessarily used examples from Rahn specifications for a 6-ft. surface plate, it is hoped that the 3-point specification will enable users of all surface plates to analyze their needs and to write their own specifications. Thus they may tell their surface plate supplier exactly what they want and be sure they will get what they require.

Control Unit Incorporates A Memory Device for Continuous Gaging

Storing a meter reading of varying magnitude and reproducing that information at a later period is the function of the Proportional Syncronizer, a device recently developed by Pratt & Whitney.

In operation, a meter reading from a gage is applied to the memory unit through a self-balancing electronic control circuit. The device storing this reading is driven from the process line in the same relation that the material is progressing through the process, and the advancement of the information on the memory unit is in relation to this movement in both speed and distance.

An example of the Proportional Syncronizer being applied, is in the control of a process where steel strip, of varying thickness, is being formed into tubing and seam welded. The welding current must be varied in accordance with the thickness of the strip. If the current were held constant, and the material became thicker, a weak weld would result; and if the material became thinner, the seam would be burned. Since it is impractical to measure the thickness of the material at the point of welding, it is done before forming into a

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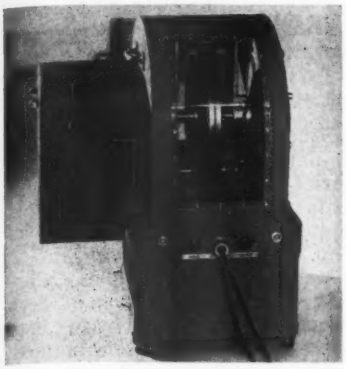

tube. The Proportional Syncronizer is therefore used to convey the information on thickness between the point of measurement and the point of welding, and to control the welding current accordingly.

Another example of a Proportional Syncronizer application is in the processing of coated materials where it is desired to know accurately the weight or thickness of the coating. A gage is employed to measure the base material continuously and the varying dimensional reading from this gage is fed into the Proportional Syncronizer. As the measured material progresses through the coating process, the meter reading progresses proportionally in the memory device. A second gage is then employed to measure the base material plus coating. The reading of the first gage after being delayed in the memory unit, is subtracted from the reading of the second gage. Inasmuch as the memory unit has delayed the reading of the first gage an amount equivalent to the time required for the specific portion of the base material to reach the second gage, the difference in the two readings is a measure of the coating thickness of that portion. By the use of the Proportional Syncronizer an accurate measure of the coating thickness only is obtained, even though the base material may vary from portion to portion by amounts greater than this coating thickness.

The Proportional Syncronizer can be applied to the storage of any meter reading of varying magnitude where subsequent use of this meter reading is required in a process operation.

For more information write Pratt & Whitney, Div. Niles-Bement-Pond Co., West Hartford 1, Conn. or **Circle No. D1.**

Tag Designed To Speed Tool Repair

Designed to assist both in portable-tool repair and in the inventory of repair parts is a new tool repair tag devised at the TEMCO Aircraft Corp. of Dallas, Texas. One side of the card lists services needed most frequently for small electric and air tools. The operator checks the appliable block, or makes his request under "Additional Remarks," as the operator of this rivet gun has done. The card's opposite side, as the blank tag above indicates, has columns in which parts used in repair are logged. The card —except for a detachable stub— is filed as a permanent tool repair record.

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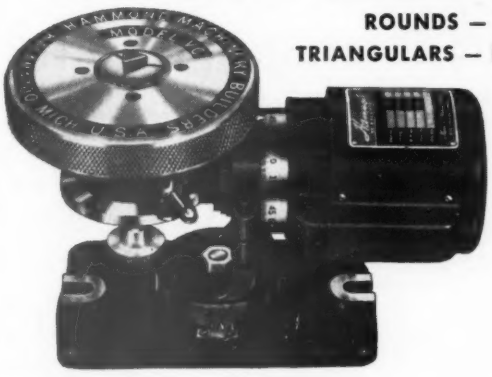
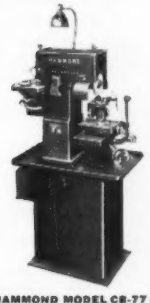


MODEL VC, Style M Motorized Solid Carbide Insert Grinding Fixture. Style H, without motor also available. Write for Bulletin No. 235.

THE Hammond Solid Carbide Insert Grinding Fixture pays for itself in a few weeks. Offers a fast, economical and accurate means of grinding chip breaker grooves in round, square, triangular and rectangular shapes and for rough and finish grinding of dull and damaged carbide inserts. Motorized Style M with lug base can be mounted on most tool and surface grinders and Hammond CB-76, CB-77 and CB-77W Chip Breaker Grinders.



HAMMOND MODEL CB-77 CHIP BREAKER AND DIAMOND FINISHING GRINDER can be supplied with both the standard Any Angle Vise and the Model VC Solid Carbide Insert Grinding Fixture.

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CIRCLE INFORM-A-GRAM KEY NO. 1411

UNDERSTANDING THE UNIFIED SCREW THREAD SYSTEM

A non-technical description of the Unified Screw Thread System, presenting basic screw thread data and terminology including a comparison of the Unified and the American National Systems.

THE UNITED STATES and Great Britain have for many years produced threaded parts based on differing screw thread systems. The former has employed the American National System, and the latter the British Whitworth System. Chief among the differences in the two systems are thread form (a 60° angle in the American system, a 55° angle in the British), thread series, and class of thread. Thus, nuts manufactured in the United States would not fit British bolts and British screws would not fit American threaded holes. Canada, serving the needs of both countries, has had to use both systems as requirements dictated.

Though absence of standardization impeded industrial and trade relations between the United States and Great Britain for many years, no concerted action towards unification was initiated until 1943. At that time inability to properly maintain and service the vast amount of American military equipment on British soil dramatized the need for standardization and the first international conference on screw thread unification took place.

by Julian Leventhal
Design Standards Dept.
ALLMETAL SCREW PRODUCTS CO., INC.
Garden City, New York

Through continuous discussions, compromises and experimentation, considerable progress was made during the following five years. Finally, on November 18, 1948, an accord was signed between the United States, Great Britain and Canada adopting the Unified Screw Thread System as the common standard to be used by these countries in the production of threaded parts.

The most important of the differences between the two systems were settled under this accord. However, as a living and growing system, the Unified Screw Thread Standard is constantly being examined, revised and expanded to better meet the needs of the countries involved, and many of its present features are of recent origin. Among these newer developments are the inclusion of some numbered screw sizes in the system, and the change from the ½-12 size which was originally adopted, back to the ½-13 size, as in the old American National System.

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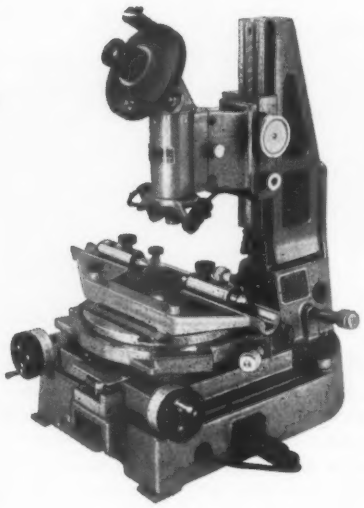

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CIRCLE INFORM-A-GRAM KEY NO. 1421

Screw Thread Terminology

In order to better understand the new Unified Screw Thread System a glossary of basic screw thread terms follows, avoiding technical usage and in some instances deviating from standard definitions with a view towards simplification.

SCREW THREAD — A projecting ridge of material, spiralling uniformly around the outside or inside of a cylinder.

EXTERNAL THREAD (also called Male thread) — A thread on the outside of a cylinder (ie: screw, bolt, stud, etc.).

INTERNAL THREAD (also called Female thread) — A thread on the inside of a cylindrical hole (ie: nut, threaded hole, etc.).

RIGHT-HAND THREAD—A thread which turns in a clockwise direction. Unless otherwise specified, all screw threads are assumed to be right-hand.

LEFT-HAND THREAD — A thread which turns in a counter-clockwise direction. All left-hand threads must be specified, usually by the use of the symbol "L.H."

TOLERANCE — The total variation allowable in a given size. A "Plus" tolerance is added to the basic size; a "Minus" tolerance is subtracted from the basic size. Example: Given a part of 0.250" diameter with a tolerance of plus 0.005" and minus 0.005" (a total tolerance of 0.010"), the finished part will be acceptable if it actually measures anywhere from 0.245" to 0.255" diameter inclusive.

ALLOWANCE (positive) — The intentional clearance left between two mating parts, such as a screw and nut, after assembly. Example: Based on the extreme tolerance limits, if a screw and nut are both 0.250" diameter, there is no allowance. If the screw is 0.245" and the nut is 0.250" diameter there is an allowance (positive) of 0.005". (Note: the less common "negative" allowance is an interference between mating parts. Thus a screw of 0.255" diameter and a nut of 0.250" diameter have a negative allowance or interference of 0.005".)

FIT — The relationship between two mating parts with respect to the amount of clearance or interference present when they are assembled. Thus we have the broad terms "tight fit", "loose fit", "interference fit", etc. The term "fit" indicates a general condition, rather than any specific dimensions.

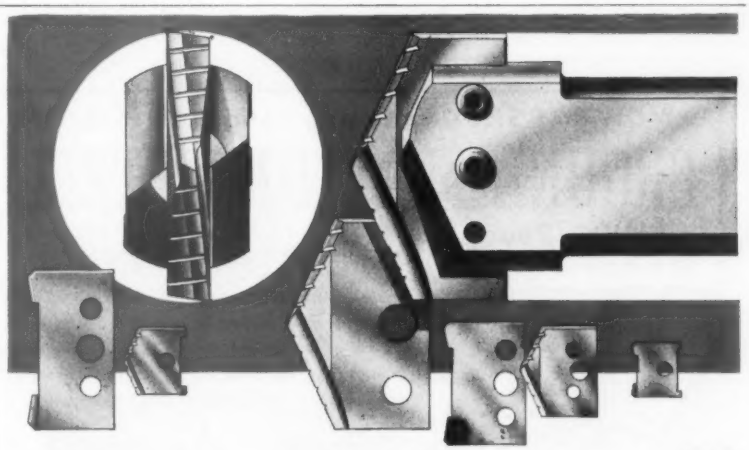
CLASSES OF THREAD — Classifications used to distinguish threads from each other, based on the amount of tolerance or combination of tolerance and allowance specified. (Note: formerly known as "classes of fit," which terminology is still widely used.)

NUMBER OF THREADS PER INCH (abbreviated T. P. I.)—A specified number of complete threads on each one-inch length of threaded part. The actual number of threads present varies in proportion to the length of the part. Example: Given 20 threads per inch as the standard, a screw ½" long will have 10 threads, and a screw 2" long will have 40 threads.

SCREW THREAD DIAMETER — The basic outside (or major) diameter of a threaded part, male or female. This is not a technical descriptive term, but is commonly used in referring to screw threads. Thus we speak of a ¼" bolt, a ⅜" nut, etc. For diameters under ¼", a series of standard numbers is used to designate a specific size (ie: No. 10 is 0.190" diameter, No. 4 is 0.112" diameter, etc.)

THREAD SERIES — An accepted listing of screw thread diameters in which each diameter has a specified number of threads per inch (T. P. I.). Examples: In the Coarse thread series a ¼" diameter thread will always have 20 T. P. I. (¼-20). In the Fine thread series,

. . . *Continued on page 144*



Drill Large Holes from the Solid with Interchangeable Spade Drills

Made in 256 cutter sizes, 1 to 5 inch diameter, in steps of 1/64, Conner type Spade Drills drill the required diameter in one operation, need no retracting to clear them of chips. Only eight sizes of holders are needed to handle all cutter sizes.

For general purpose work and in the Tool Room, use the cutter and holder assembly shown above. It is a rugged tool of great rigidity, recommended for large holes of medium depth.

For Production Drilling (for repetitive work), and for the somewhat deeper holes, use Conner type Oil Hole Holders designed for easy coolant flow and fast chip expulsion.

Send for Catalog and Price List

For Boring: Core Drill Cutters, for semi-finishing of cored and drilled holes, are made in the same 256 sizes, to fit the same spade drill holders.

The Gairing Tool Company is now the exclusive manufacturer of the Spade and Core Drills, both standard and special, formerly made by the Conner Tool & Cutter Company.

In Canada: A. C. Wickman (Canada) Ltd., Queensway, Toronto 14

The GAIRING Tool Company

21227 HOOVER ROAD, DETROIT 32, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 1431

. . . Thread System, from page 143

a ¼" diameter thread will always have 28 T. P. I. (¼-28).

SCREW THREAD SYSTEM — An accepted standard which outlines specifically all details of threaded parts, including thread form, tolerances and allowances, classes of thread, thread series, etc. for general or specialized use. Examples: Widely used screw thread systems are the American National, Unified, American National Pipe Thread, Acme Thread, (British) Whitworth, etc. Screw thread systems for specialized use include the Buttress Thread, Microscopic Thread, Petroleum Institute Thread, etc.

What Is a Unified Screw Thread

Most of the difficulty in understanding the basic principles of the Unified system arises from the double meaning of the term "Unified Screw Thread". The Unified Accord adopted by the United States, Great Britain and Canada in 1948 actually included two major areas of agreement.

The first area pertains to thread **design** and presents a series of formulas and standards covering the tolerances, allowances, and form of thread to be followed in their production. Thus any screw thread can be made to these specifications and be properly called "Unified".

The second area pertains to thread **sizes** selected from the various American and British thread series that are to be considered as standard among the three countries involved. When made to the Unified screw thread formulas, these sizes only may be considered as "Unified".

Thus the term "Unified Screw Thread" can be used to denote either thread **design** only or thread design and **size.**

In the design of new parts Unified sizes should, of course, be specified wherever possible in order to accomplish the principal purpose of unification. However, since all screw thread sizes in the United States are affected by the Unified Standard formulas (including non-Unified sizes such as 2-56, 5-40, 1"-14, etc.), we are primarily concerned with those provisions of the Unified Standard pertaining to thread **design.** It is important to remember these two applications of the term "Unified Screw Thread" whenever the term is used.

Status of the American National System

As noted above, the United States has adopted the Unified thread as the basic form of screw threads. However, the Unified System does not eliminate the older American National System but rather supplements it. Under the new standards adopted by the government, Class 1 and Class 4 of the American National System have been eliminated entirely as being unsatisfactory, but Class 2, Class 3 and Class 5 (modified) are still in effect. However, as Unified threads become more widely used, it is expected that the remaining American National threads will be used less and less, and will probably be eliminated at some future date.

At the present time, it is obviously necessary to continue the use of the American National Thread System in order to use up existing stocks of parts made to that standard, to secure replacement of threaded parts now in use and made to that standard, and to meet special needs not yet covered by the Unified System.

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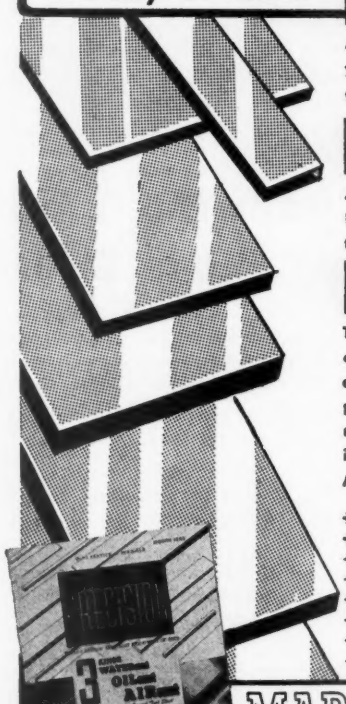

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Form of Unified Screw Threads

For all practical purposes, the form of the Unified screw thread is the same as that of the American National form since it retains the 60° thread angle. It should be pointed out, however, that this thread form necessitates a drastic change by British manufacturers since their previous thread had an angle of 55°.

Other slight changes were made involving the shape of the threads, but they are of minor importance. These changes cover the use of round or flat crests and roots of the threads, which do not affect their ability to be used interchangeably. In fact, because of variations allowed under the Unified form, it is expected that American manufacturers will continue to use exactly the same thread form as before.

Unified Thread Series

The American National screw thread standards had two basic thread series: Coarse and Fine. These covered most of the requirements for threaded parts and were by far the most widely used.

For special applications, however, these were sometimes found unsatisfactory, and other combinations of diameter and T. P. I. were formed into additional thread series. These are the Extra-Fine, 8-thread, 12-thread, 16-thread and Special thread series, all of which have their individual advantages.

As an example of the use of these special series, let us consider a ⅜″ nut with a thickness of ⅛″. Using the Coarse thread series (⅜-16 T. P. I.), the thickness of the nut would result in it having only two threads, and using the Fine thread series (⅜-24 T. P. I.) it would still have only three threads. However, by using the Extra-Fine series, in which a ⅜″ diameter part has 32 threads per inch, the same nut will have four threads, which may be necessary for a particular application to provide greater holding power. In the same way, each of the other thread series has its own particular advantage.

Under the Unified standards, some of the sizes in all thread series have been accepted as Unified in the sense of international standardization. In the Coarse thread series, ¼″ through 4″ diameter sizes are so Unified, and in the Fine thread series, ¼″ through 1½″ diameters. Because of the comparatively infrequent use of the special thread series, no details are given here, but complete listings of Unified sizes are readily obtainable from various publications.

Some of the numbered screw thread sizes have recently been included in the Unified system, and these are 4-40, 6-32, 8-32, 10-24 and 10-32.

The only change from previous American thread series is in the 1″ diameter in the Fine series. Where it was 1″-14 T. P. I. under the older standard, it has been changed to 1″-12 T. P. I. under the Unified System.

It is expected that as talks continue between the countries concerned with Unification, additional sizes will be Unified with eventual unification of all screw thread sizes as the ultimate goal.

Designation of Unified Thread Series Sizes

... Continued on page 146

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. . . Thread System, from page 145

With one exception*, all screw thread **sizes** which have been Unified (and are, of course, made to the Unified screw thread formulas), are so designated by placing the letter "U" before the thread series. Thus, the ¼-20 size is indicated as ¼-20 UNC to indicate Unified Coarse series. Where a screw thread size has not been included in the internationally adopted Unified sizes, the letter "U" is not used, even if the thread is actually made to the Unified formulas, as for example 1"-14 NF.

Where sizes have been Unified within a thread series, the designations are as follows:

UNC — Coarse thread series — Unified
UNF — Fine thread series — Unified
UNEF — Extra-Fine thread series — Unified
8-UN—8-Thread series—Unified
12-UN — 12-Thread series — Unified
16-UN — 16-Thread series — Unified
UNS — Special thread series — Unified

The presence or absence of the letter "U", therefore, only indicates whether or not a particular **size** is Unified (with the single exception noted). Designation of screw threads with Unified **design** but not necessarily Unified size is described in the following section.

*The recently Unified numbered sizes will not take the letter "U" designation, but will continue to be shown as before (ie: 4-40 NC; 10-32 NF; etc.)

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Unified Classes of Thread

Under the American National system of screw threads, the formulas for determining tolerances and allowances within a particular class of thread are the same for internal and external threads. Thus a Class 2 thread indicates a series of tolerances regardless of whether an internal or external thread is involved. Under this system, there are three basic Classes of Thread — Class 1, Class 2, and Class 3.

The Unified system has six basic Classes of Thread — Class 1A, 1B, 2A, 2B, 3A, and 3B, where "A" indicates an external thread, and "B" indicates an internal thread. (This use of the letters "A" and "B" is the positive identification of a thread made to the Unified formulas). Unlike the American National system, the tolerances and allowances for an internal thread differ from those for an external thread, and therefore Class 2A and 2B are basically different classes.

In all classes of thread, the Unified system allows for a 30% greater tolerance on internal threads than on external threads. Thus the tolerances on the dimensions of a Class 2B thread will be 30% greater than the tolerances on a Class 2A thread. Since it is much more difficult to hold close tolerances in the manufacture of internal threads than it is on external threads, this 30% greater tolerance is a practical step taken to make screw threads fit in with actual manufacturing problems. Comprehensive tests have indicated that this change does not decrease fastening qualities to any appreciable degree.

The Unified system provides for an allowance on the Class 1A

and Class 2A (external) threads. By making the threads in these classes always slightly "undersized", a freer fit is provided. This permits quick and easy assembly of mating parts and helps eliminate seizing and galling of threads, especially in high speed automatic assemblies. Also, this allowance provides space for the additional thickness which is added when a screw is plated or otherwise coated. This was an important step; because, without this allowance, it is possible that the additional plating thickness could make a screw too big to fit into a nut, or at least cause difficulty in assembly. Under the American National system, only the Class 1 external thread provided this allowance, and this class thread was not widely used for commercial production. Again, comprehensive tests have indicated that providing this allowance does not affect fastening qualities to any appreciable degree.

In general, the new Unified classes of thread correspond to their similarly numbered American National classes. Thus a combination of Class 2A and 2B is basically equal to the older Class 2, etc. Although the Unified screw threads result in a somewhat "looser" fit than their corresponding American National classes, this has been found to be advantageous in almost all instances, because of the more practical basis for the setting of tolerances and allowances.

Applications of the Unified Thread Classes

Classes 1A and 1B cover applications where quick and easy assembly of threaded parts in necessary, even where the threads are slightly damaged or dirty. This is obtained by providing the largest tolerance plus an allowance, and results in a comparatively "loose" assembly. The allowance on the Class 1A (external) thread helps provide this easy assembly, and also allows for plating.

Classes 2A and 2B are primarily designed for screws, nuts and bolts. By providing smaller tolerances plus an allowance, a tighter though still fast and easy assembly is effected. The allowance on the Class 2A thread provides for plating of the part.

Classes 3A and 3B provide for applications where mating parts must assemble with greater precision and have a minimum of looseness or play. These screw threads are normally used on precision equipment, and require much greater care in manufacture. No allowance is provided in these classes, and tolerances are held to a minimum.

It is expected that Classes 2A and 2B will be the most widely used, and that Classes 1A and 1B or Classes 3A and 3B will meet the requirements of almost all other threaded parts. In some instances, however, it may be found desirable to "mix" classes of thread. For example, by using a Class 2A (external) thread with a Class 3B (internal) thread, a tighter fit will be provided, while still providing an allowance for plating.

In discussing the various classes of thread, it must be remembered that in all instances these variations are brought about by comparatively small changes in tolerances and/or al-

. . . *Continued on page 148*

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. . . Thread System, from page 147

lowances. In spite of the fact that these minor variations will provide different types of fit, any class of external thread can be physically used with any other class of internal thread, either Unified or American National.

Thus, to reinforce a loose table leg by use of a bolt and nut, it would make little difference what class thread was used in manufacturing the bolt and nut. Any class or combination of classes could do the job satisfactorily, although Class 2A and 2B would probably be commercially available. This same thought applies in many industrial applications.

In the fields of mass production and precision instruments, these seemingly small variations would, of course, assume greater importance. Where screws and nuts must be rapidly assembled on an automobile assembly line, for example, the use of Class 3A and 3B combination would probably cause trouble because the combination of tight fit and use of high speed assembly procedures might cause the threads to bind. This is especially true if the screw has been plated prior to assembly. On the other hand, a combination of Class 1A and 1B threads in a precision instrument might allow too much play between the assembled parts, and seriously interfere with the proper working of the instrument. As a result of these various factors involved, it is usually the task of the design engineer to determine what class threads should be used on any specific part, bearing in mind the availability and cost factors involved in the different screw thread classes.

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Other Unified Screw Thread Changes

There are several other changes incorporated in the Unified system which vary from the American National system, but in general these relate entirely to determining of formulas, gaging methods, etc. In the normal use of screw threads by the nontechnical person, these changes are of little or no importance. Since it is unlikely that any of these questions will arise in the course of daily activities, they are not herein discussed.

Interim Change-Over Period

When we consider the large percentage of our manufactured products that employ the use of threaded parts, it becomes apparent that a change in the basic screw thread standards must have a tremendous impact upon American Industry.

It would be virtually impossible for manufacturers to immediately make all the necessary changes in production, gaging and the various other aspects of manufacturing procedure which are required to change to the Unified system of screw thread production. For reasons of economy, time involved in obtaining new equipment, standardization of policies, etc., the change to this new system has been, of necessity, a gradual one.

A further detriment to immediate adoption of the Unified system is the fact that manufacturers, wholesalers and users of threaded parts normally keep a stock of parts on hand for future use. To avoid the great loss of time, money and production

which would result if these parts were declared obsolete because they were made to the older American National standards, provision must be made for using up these parts.

Finally, in spite of the similarity of the two standards, there will be instances in which products incorporating screw threads made to the American National standards require replacement parts made to that system for optimum performance.

Recognizing the fact that the change to the new standards must necessarily be a gradual process, an interim transition period is generally provided, during which time screw threads manufactured to either of the two standards will be acceptable. Where Unified threads are specified, American National threads will be an acceptable alternate, and where specifications still call for American National threads, the newer Unified form may be supplied.

This transition period, when allowed, is usually an indefinite period of time, and it is anticipated that it will be extended until such time as Industry has completed the change to the Unified system.

Although the changes incorporated in the new Unified system provide definite advantages over the American National system, it must be remembered that these changes are comparatively small. And, as has been noted, any class internal thread may be assembled with any other class external thread, regardless of whether the classes are Unified or American National. Therefore, in most applications, it will be found practical to permit this optional supplying of threaded parts made to either of the two standards during this transition period, and for the sake of economy and convenience, this practice is to be recommended wherever possible.

Changes in Governmental and Industrial Standards

Almost all the production of threaded parts is based on standards set by the various governmental agencies and industrial users. With the acceptance of the Unified Screw Thread System as the basic standard for the United States, these various specifications are gradually being revised to conform to this standard. Where American National threads have been specified on blueprints and specifications issued by industry and the government, they are being revised to call for Unified threads.

In many instances where Unified threads are now specified, the transition period is taken into account, and blueprints and specifications will state that threaded parts made to the American National system are acceptable as an alternate. Very often, however, a blueprint will specify Unified threads only, with no alternate shown. In these cases, it is necessary to see if some more basic specification is referred to on the blueprint permitting the use of American National threads during the interim period. An example of this is in the "A-N" specifications.

"AN505", a government standard blueprint and table of sizes specifying a Flat Head Machine Screw, in its latest revision speci-

. . . *Continued on page 150*

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. . . Thread System, from page 149

fices Unified screw threads, with no alternate indicated. However, the manufacturing specification on the AN505 blueprint refers to Federal Specification FF-S-92. This publication, giving the various standards to be used in the manufacture of this screw, including the thread form, specifically allows for a transition period (indefinite) during which time American National screw threads will be acceptable as an alternate. In effect, therefore, although the original "A-N" standard does not permit the use of American National screw threads, the more basic specification referred to does allow this choice.

The reverse is also true at times. Some specifications still specifying American National threads allow the use of Unified threads during the interim period to cover those manufacturers who have already made the change. Again, basic reference specifications must be checked to determine if this transition period allowance is provided.

In order to avoid rejections of material and costly delays, it is important that persons dealing with screw threads be aware of these various basic specifications, and thus to know when only one standard screw thread may be furnished or when there is an alternate allowed. Too often, basic government specifications are specified or applied in a routine manner without an awareness of the changes that have been made in them during the past few years. With the adoption of the Unified System, most of these government specifications have been or are being revised at the present time, with resulting significant consequences.

Basic Government Screw Thread Specifications

The scope of this article does not permit a comprehensive listing of the many governmental and industrial standards covering screw threads. There are, however, several specifications issued by the government and industry which are widely used as reference and may well be considered the basis for screw thread production in the United States. These are:

Federal Handbook H-28 (1944) and the 1950 Supplement —

"Screw-Thread Standards for Federal Services"

American Standards Publication ASA B1. 1-1949—"Unified and American Screw Threads"

Military Specification MIL — S-7742 (1951)—"Screw Threads".

NTDMA Plans 1954 Annual Meeting And Convention

The 1954 Annual Meeting of Members and Board of the National Tool and Die Manufacturers Association is to be held at the Dayton Biltmore Hotel, Dayton, Ohio, on November 4-7.

An outstanding feature of the Convention this year will be two plant tours. At the Sheffield Corporation attendants will see the very latest developments in shop equipment for tool and die shops with special demonstrations on toolroom gages, instruments,

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A full program of business and social sessions as well as planned entertainment for the ladies will make this convention a "must" for 1954.

Details and reservations may be obtained by contacting the National Tool & Die Manufacturers Association, 907 Public Square Building, Cleveland 13, Ohio.

Jones & Lamson Machine Tool Company has announced the appointment of the Rickert Industrial Supply Company of Milwaukee, Wisconsin as a stocking distributor of J & L automatic opening die heads, chasers and fixtures. The new distributorship will cover Eastern Wisconsin and Northern Michigan.

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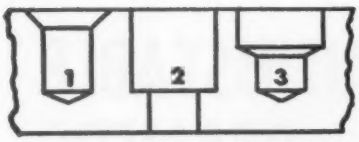

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Subland Drill (2-2) will (1) drill-countersink, (2) drill counterbore, or (3) drill-drill.

This is called a "Size-Optional" subland tool which is machined, hardened and placed in a stock bin. This results in a material saving to the customer in original cost and reduces delivery time to a fraction of that usually required for special tools.

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Reamer sizes and range: from ¾" to 4".

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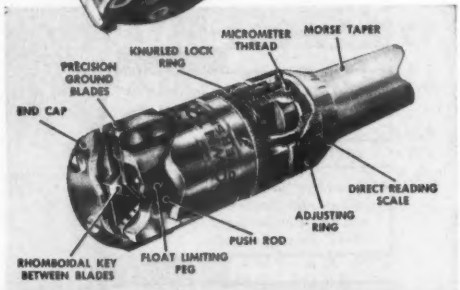

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At the top of the bar a large micrometer thimble graduated to 0.0001" provides intermediate dimensions between the bar's 1" steps. With use of a reverse checking plate, a height gage indicator is easily set for checking the underside of workpieces. Use of inside micrometers, telescoping gages, and internal cylinder gages is provided by settings between the reverse checking block and gaging button on the base. **Circle Inform-A-Gram No. D4.**

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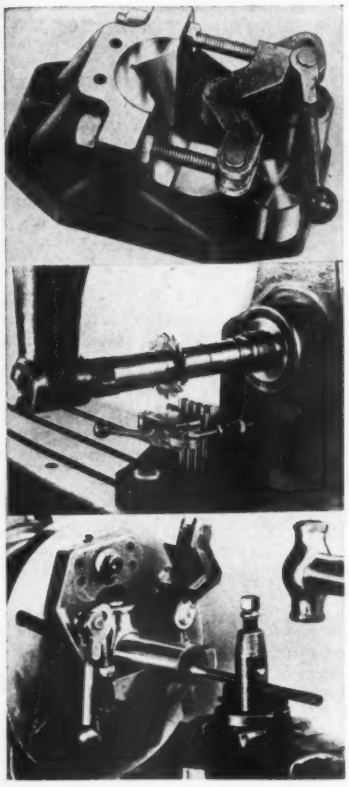

as well as regular. The basic tool on this holder, manufactured by Lassy Tool Co., Plainville, Conn., is a heavy ribbed casting properly normalized and precision ground, having a base with slots for bolting to the machine table or face plate.

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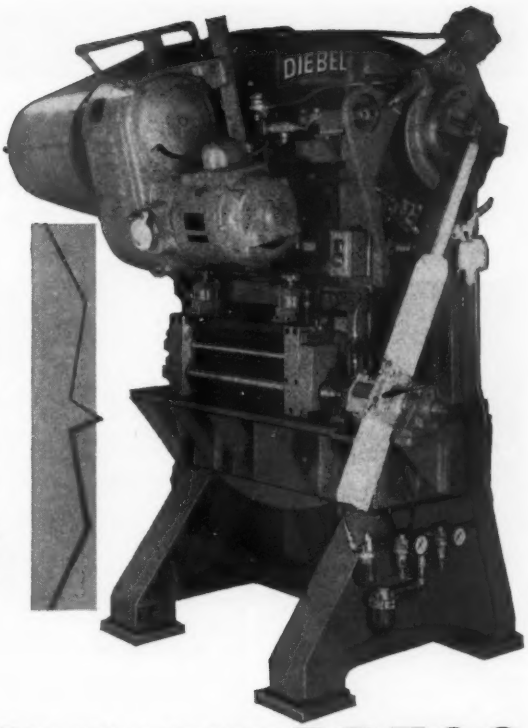
U. S. SAVINGS BONDS

NOW STAMP STOCK UP TO 23" WIDE



DIEBEL 40 TON AUTOMATIC Back To Front Feed PRESS

Manufacturers of parts involving wide and relatively light stock have been faced with the problem of buying a big tonnage press to get the needed bed area and feed width. This has been unsatisfactory not only because of higher initial investment, but the direct and indirect costs of maintenance, power and slow rate of speed.

Di Machine has designed a press to meet the specific needs of these manufacturers.

The 40 Ton Diebel Automatic Press with back-to-front feed has proved to be the most economical method of mass producing wide, light stampings.

Stock up to 23" wide with a length of feed from 0 to 13" can be mass produced from 72 to 360 strokes per minute on the 40 Ton Diebel Automatic Press.

DIEBEL HI-PRODUCTION AUTOMATIC PRESSES

DI MACHINE CORP.

2708 W. IRVING PARK ROAD • CHICAGO 18, ILLINOIS

CIRCLE INFORM-A-GRAM KEY NO. 1531

ARE YOUR PRODUCTION AND PROFITS GOING INTO THE SCRAP HEAP?

UP TO 80% OF YOUR PARTS REJECTS AND FIXTURE REWORK COSTS CAN BE ELIMINATED WITH THE VLIER AUTOMATIC TORQUE THUMB SCREWS

AVAILABLE IN FOUR TYPES

REGULAR —Type A
for normal supporting

INVERTED—Type B
Reverse of Type A support

TEE HEAD—Type C
used with sliding V-blocks

ADJUSTABLE—Type D
set your own holding pressures

HERE'S WHY—

VLIER Torque Thumb Screws are simple holding tools that give controlled support for even fragile work pieces against machine tool pressures. An automatic ball check in the head prevents further tightening once a pre-determined holding pressure is reached. Thus, no distortion—no rejects. These tools are operated by finger pressure only, and work without fail in noisy, greasy or dark places because they are *automatic*. Accuracy and uniformity are guaranteed and there is nothing to wear or break. It will pay you to apply VLIER Torque Thumb Screws to your production problem.

Send for Catalog No. 50

VLIER

VLIER ENGINEERING, INC.
4552 BEVERLY BLVD., LOS ANGELES 4, CALIFORNIA
Distributors of Spring Plungers, Spring Stops, Fixture Keys, Toggle Pads.

CIRCLE INFORM-A-GRAM KEY NO. 154

Will You Be There?

Oct. 14-15. Illinois Institute of Tecnology and Armour Research Foundation. National Conference on Industrial Hydraulics. Hotel Sheraton, Chicago.

•

Oct. 18-19. American Society of Mechanical Engineers and American Society of Lubrication Engineers. Lubrication Conference. Lord Baltimore Hotel, Baltimore, Md.

•

Oct. 18-22. 42nd National Safety Congress and Exposition. Conrad Hilton, Congress, Morrison, and LaSalle Hotels, Chicago.

•

Oct. 24-27. American Gear Manufacturers Association. Semi-annual Meeting. Edgewater Beach Hotel, Chicago.

•

Oct. 25-27. American Institute of Electrical Engineers. Machine Tool Conference. Hotel Statler, Detroit.

•

Oct. 27-29. American Society of Body Engineers, Inc. Technical Convention. Rackham Memorial Building, Detroit.

•

Nov. 1-5. American Welding Society. National Fall Meeting. Sherman Hotel, Chicago.

•

Nov. 4-7. National Tool & Die Manufacturers Association. Annual Convention. Dayton Biltmore Hotel, Dayton, Ohio.

•

Nov. 10-12. Gray Iron Founders' Society, Inc. 26th Annual Meeting. The Homestead, Hot Springs, Va.

•

Nov. 10-12. Industrial Management Society. Time and Motion Study and Management Clinic. Sherman Hotel, Chicago.

•

Nov. 15-17. American Standards Association. National Conference. Hotel Roosevelt, New York City.

•

Nov. 15-17. The Magnesium Association. Annual Meeting. Hotel Chase, St. Louis.

•

Nov. 29-Dec. 2. First International Automation Exposition. 244th Regiment Armory, New York City.

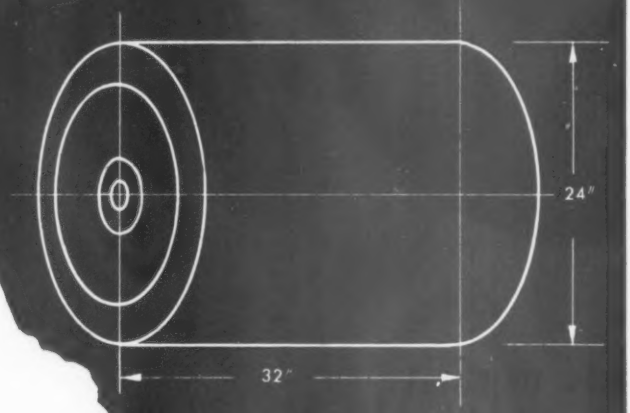
•

Nov. 30-Dec. 2. First Electronic Computer Clinic. 244th Regiment Armory, New York City.

MEEHANITE®

METAL CYLINDERS

Assure accurate control in printing plastic wrapping film . . . A critical factor in printing plastic wrapping films is the precise control of ink film thickness. Cylinders of unbelievable *permanent accuracy* are a must for accurate control.



Can We Help You With Your Problems ????

The heart of this equipment is a Meehanite cylinder—designed and processed to engineering specifications developed by Fulton Foundry & Machine Company, Inc., to take full advantage of the unique combination of physical properties found in Meehanite castings.

These cylinders reach a size of 48″ diameter by 60″ long, although, the one shown above is roughly 24″ diameter by 32″ long.

After being machined and assembled, the cylinder is finish ground, running on its own super precision bearings to a *maximum runout of .0005″ T.I.R.* which it *will hold for a period of years.*

Meehanite castings are widely used in the printing machinery industry for their well known properties of high strength, density. good wearing and permanent stability, for gears, cams, cylinders, ink fountain rolls, etc.

FULTON FOUNDRY & MACHINE CO., INC.

East 75th & Morgan Avenue • Cleveland 27, Ohio • Phone MI 1-8400

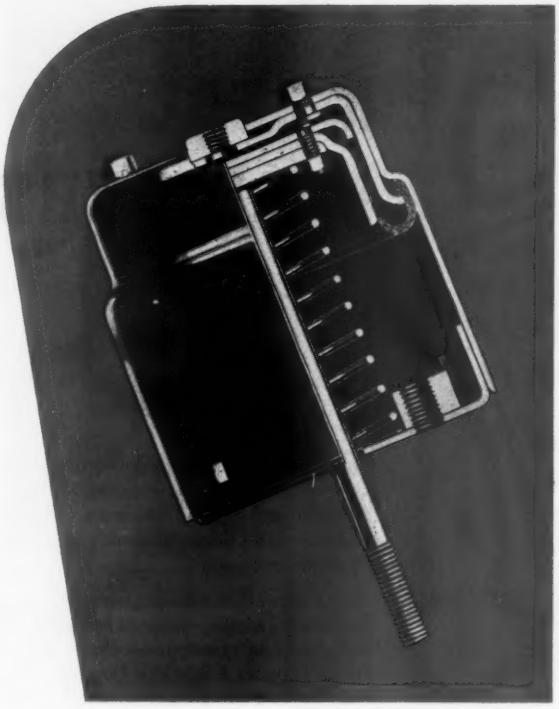
EQUIPPED FOR HEAVY, MEDIUM OR LIGHT JOBBER PRODUCTION
HEAVY JOBBING MACHINE SHOP—METALIZING

CIRCLE INFORM-A-GRAM KEY NO. 1542

Make TELCO

your AIR or HYDRAULIC CYLINDER Service Center

You can HOLD, CLAMP, BEND, SWEDGE, STAKE or RIVET better, faster and cheaper with air or hydraulic cylinders.



BENDIX-WESTINGHOUSE AIR CYLINDERS

Short stroke diaphragm operated
Simple positive action requires no maintenance
Built for exceptionally long life
Designed for easy installation in small spaces

IMMEDIATE DELIVERY FROM STOCK

CARTER AIR or HYDRAULIC CYLINDERS

Standard piston operation
Compact construction with minimum diameter requiring one third to one half of usual space
Internal locking key gives strongest possible union yet permits full 360° rotation of head mount
Easily installed with any of six standard mounts
Unusual 1 to 1 bearing surface ratio
Readily disassembled for easy maintenance AA-218

TELCO

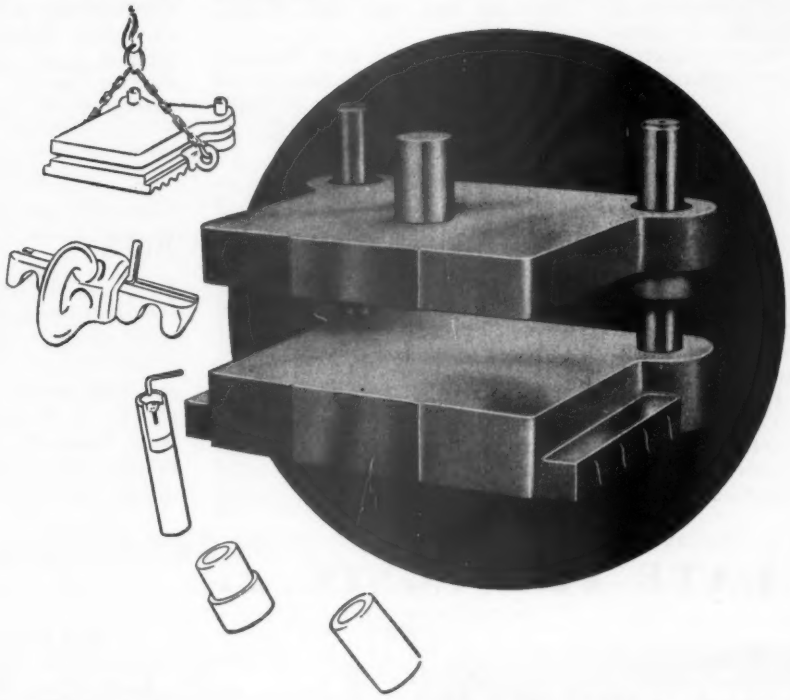
TRUMAN E. LONGLEY CO.
4030 SUPERIOR AVENUE
CLEVELAND 3, OHIO

FOR TOOL AND PLANT ENGINEERING NEEDS CALL ENdicott 1-1560

TOOL DIVISION: Drills, Taps, Carbide Tools, Rotary Files, End Mills, Milling Cutters, Diamond Wheels, Air & Hydraulic Cylinders, Valves & Controls, Machinery & Equipment.
PUMP AND FILTER DIVISION: Pumps, Filters, Electric Switches and Controls, Calibrating Tanks and Separators, Gauges, Thermometers, Compressors, Safety Tools, S. S. or Alloy Tanks and Vessels.

CIRCLE INFORM-A-GRAM KEY NO. 1543

FAMOUS SUPERIOR DIE SETS NOW AVAILABLE FROM JERGENS



ONE STOP SERVICE FOR THE FOLLOWING TOOL ROOM NEEDS

ACME STANDARD BUSHINGS:
Drill Jig Bushings and Liners stocked in ASA & Acme Standard finished or with Grinding Stock; Liner pins and liner pin bushings; Leader pins and leader pin bushings.

FASTENERS & LOCATORS:
Socket Set Screws; Hex & Socket Head Cap Screws; Shoulder Screws; Flat Head Cap Screws; Pipe Plugs Regular & Dry Seal; Dowel & Taper Pins + .002 Dowels; Allenuts; Hex Head Nuts, Screws, Washers.

JERGENS STANDARD COMPONENTS:
Over 500 Standard parts including: Blank Jaws; Sine Fixture Keys; Clamp Shoe Assemblies; Thumb Screws; Jig Rest Buttons; Quarter Turn Screws; "C" Washers; Hand Wheels; Strap Clamps; Studs; Tee Set Kits, etc.

FEATURING REMOVABLE CAP GUIDE PINS

Enjoy the decided superiority of SUPERIOR DIE SETS and SUPPLIES including die springs, layout dies, lubricants, pins & bushings, bolster plates, etc., immediately available from Jergens. Superior Die Sets are available with easily removed cap guide pins that save time, effort, minimize danger of damage to costly dies.

Superior Die Sets and Accessories are distinguished for their long, accurate press runs—their precision manufacture of quality materials and for their exclusive safety features which safeguard against injury to handlers plus easier lifting and manipulating.

All these quality Superior features mean time, material and labor savings for you.

Write for complete specifications and price list.

Jergens BETTER TOOLS AT LOWER COST

TOOL SPECIALTY CO.

712 E. 163rd St. CLEVELAND 10, OHIO
KEnmore 1-2015

CIRCLE INFORM-A-GRAM KEY NO. 1544

PRUTTON CORP. IS REORGANIZED FOR EXPANSION

Forerunning new machinery developments and a major expansion program, former company President D. H. Prutton recently became Board Chairman and Howard D. Prutton, his son, succeeded him as President of the reorganized Prutton Corporation, Cleveland manufacturer of thread rolling and tapping machinery.

Formerly named the D. H. Prutton Machinery Co., the firm was operated for 25 years by D. H. Prutton. During that period the company was first to incorporate the "planetary" die principle for fast, low cost thread-rolling.

Board Chairman D. H. Prutton began his industrial career at 14 and worked his way up through the ranks in several plants to his present post in his own firm.

President Howard D. Prutton, a graduate Mechanical Engineer from Case Institute of Technology, is directing all activities of the Corporation, including a new Customer Service Department formed to provide prompt engineering service on all Prutton machinery in the field.

—•—

CLEVELAND IS LINEAR PROGRAM WORKSHOP SITE

The latest developments and techniques in the field of Linear Programming will be covered at Executive Services' Third Workshop in Linear Programming, Nov. 1 to 19, at the Hotel Cleveland, Cleveland, Ohio.

Under the direction of Nyles V. Reinfeld of Executive Services, the course is aimed at bridging the gap between the theoretical and usable aspects of the Linear Programming method of increasing production and decreasing costs.

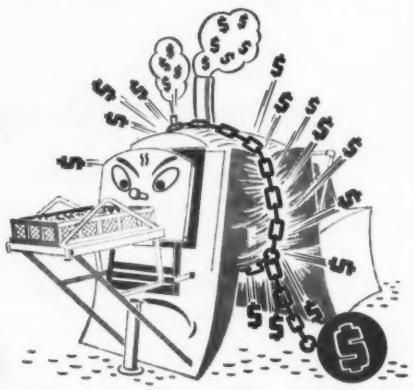
Outside experts who are specialists in various industrial fields will supplement the material presented by the regular Executive Services workshop staff. Dr. E. Leonard Arnoff of the Operations Research Department of Case Institute of Technology will lecture frequently at the three-week seminar, as will Dr. T. M. Whitin of Massachusetts Institute of Technology's School of Industrial Management.

CALCULATE THE COSTS . . .

of Your Own

Heat Treating

Department



LAKESIDE

can do it Better and Cheaper

Your own heat treating department *can* cost you *more* than to use the modern scientific facilities at Lakeside. Lakeside *specializes* in *all kinds* of steel treating. Furnaces are kept to peak heat 24 hours a day. Trained metallurgists specify the *right* treatment for every application. Your job is handled by skilled technicians with production line efficiency. Streamlined material handling puts the Lakeside plant practically at your door!

Our Services:

Electronic Induction Hardening, Carbonitriding, Flame Hardening, Heat Treating, Bar Stock Treating and Straightening (mill lengths and sizes), Annealing, Stress Relieving, Normalizing, Pack, Gas or Liquid Carburizing, Nitriding, Speed Nitriding, Aerocasing, Chapmanizing, Cyaniding, Sand Blasting. Laboratory Physical Testing.

THE *Lakeside Steel Improvement Co.*

5418 LAKESIDE AVE., CLEVELAND 14, OHIO HENDERSON 1-9100

METAL TREATING INSTITUTE

CIRCLE INFORM-A-GRAM KEY NO. 1545

—•—

ELECTRICAL GAGING PROGRAM OCT. 13

Inspection and production men from Northern Ohio are invited to attend the October 13th meeting on Electrical Gaging, sponsored by the Testing and Gaging Committee of the Cleveland Section, Instrument Society of America.

Speakers will discuss Electronic Comparator Gages, High Speed Automatic Gaging, and Continuous Gaging for Machine Control. Chairman for the program will be Watson N. Nordquist, Managing Editor of TOOLING & PRODUCTION.

The meeting is scheduled for 8:00 P.M., October 13th, at Cleveland Engineering Society Building, 2136 E. 9th Street, Cleveland. Those men desiring to have 6:30 dinner at C. E. S. should make reservations by calling Gordon Simpson, PRospect 1-4744, or Watson Nordquist, FAirmount 1-4040.

A BARKER BENCH TYPE MILL

$295.00 Complete with 1/3 H.P. motor

Barker Mills will do jobs that cannot be done on large machines.

You can hold close tolerances consistently on long run jobs.

Hundreds in use from coast to coast by nationally known manufacturers in a wide range of industries.

If you have small parts milling jobs it will be wise to check into the possibilities of the Barker Mill.

General specifications: Table 4" x 12" with 5" travel—head and spindle equipped with pre-loaded ball bearings—Head travel 3¼". Saddle travel 3". Speeds from 214 to 6000 R.P.M. Weight 160 lbs.

You'll Want the Complete Story on this Remarkable Mill. WRITE

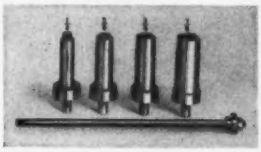
Built Right Priced Right

Special accessories on model illustrated at the right are available at slight additional cost.

A Barker equipped with coolant pan, motor driven pump, arbor support, spindle coolant shield, cutter guard and 3¼" vise.

Will Fit Right Into Your PRODUCTION PLANS

Straddle milling using our standard stub arbor.



Stub arbors with pull back rod.

Designed to take standard high speed steel or carbide slitting saws and cutters. Located in spindle with ½" collet and pulled back securely against spindle face with rod, assuring perfect alignment.

BARKER ENGINEERING COMPANY . 500 GREEN ROAD, CLEVELAND 21, OHIO

CIRCLE INFORM-A-GRAM KEY NO. 1551

When you need precision steel

DOWEL PINS

Get SAME-DAY SHIPMENT from

Order from Acme's huge stock of standard nominal and oversize Dowel Pins... shipment made within 24 hours. Whether you need a few, or many thousand, packaged or bulk, Acme can supply them FAST! Special sizes ground from semi-finished stock to fill any dowel pin requirement. Send for details now!

ACME INDUSTRIAL COMPANY

206 N. Laflin St., Chicago 7, Ill.

MFRS. OF STANDARDIZED DRILL JIG AND FIXTURE BUSHINGS

CIRCLE INFORM-A-GRAM KEY NO. 1552

100,000 R. P. M.

NU-JETT

PNEUMATIC

PENCIL GRINDER

FREE DEMONSTRATION

RIGHT IN YOUR OWN SHOP

TRY BEFORE YOU BUY!

Nu-Jett does any fine precision grinding, polishing or finishing

Use it for deburring, die work, pattern making, engraving or etching. A dependable tool — one moving part. All the advantages of high speed with ABSOLUTE SAFETY!

Size 7/8" x 5¼"
Weight 5¼ oz.
⅛" chuck

$42.50

COMPLETE
Includes Nu-Jett Grinder, Air Filter, Lubricator, Hose and Wrenches.

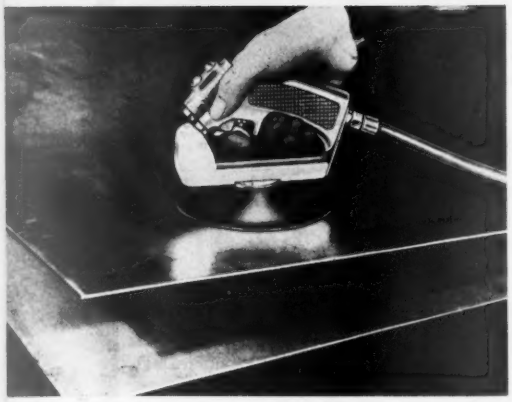
AIR EQUIPMENT CORPORATION

1355 MICHIGAN, N. E.
GRAND RAPIDS, MICH.

CIRCLE INFORM-A-GRAM KEY NO. 1553

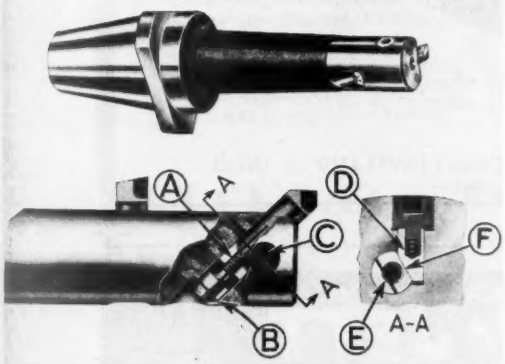
PROGRESS

NEW DEVELOPMENTS • IMPROVEMENTS • COST AND TIME SAVERS



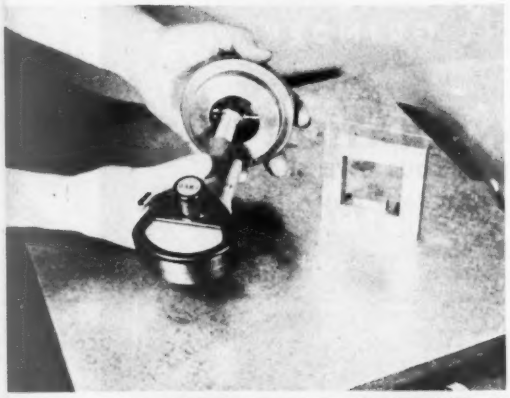
SHEET LIFTER . . .

This sheet lifter is designed for safely and easily separating and moving sheets of steel. As long as the trigger is held down, the suction cup will pull 11 pounds per sq. in. It can be used on any object that has a flat surface on which a vacuum can be maintained. Literature is available from the F. J. Littel Machine Co., Air Division, 4555 Ravenwood Ave., Chicago 40, Ill.
Inform-A-Gram No. A1.



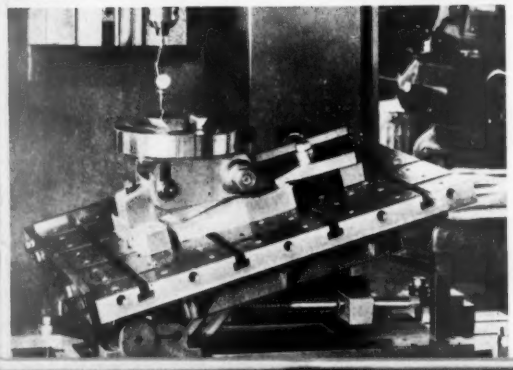
BORING TOOL . . .

This micrometer boring tool offers several newly patented features. Some of the features are shown in the illustration by the lettered arrows. To find out what features the lettered arrows point to write for the illustrated brochure offered by The Portage Double Quick Tool Co., 1046 Sweitzer Ave., Akron 11, Ohio. Write direct to the company if you wish, or just—
Inform-A-Gram No. A2.



GAGE BLOCK FRAMES

As much as 50% setup time can be saved with these precision lapped gage block frames which come in 1", 1½" 2", 2½", and 3" sizes. The frames replace parallels; eliminate difficulty when blocks are slightly worn causing parallels to give incorrect readings. Further information on the gage blocks is available from the L. E. Ottney & Co., Clawson, Mich.
Inform-A-Gram No. A3.



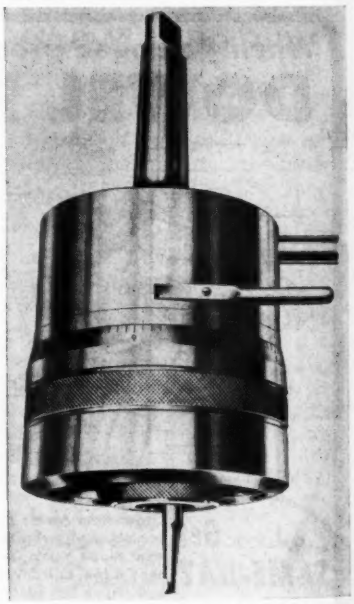
SINE PLATES . . .

Larger, single angle, nonmagnetic sine plates measuring 24" x 24" and featuring mechanical raising and lowering plate adjustments have been added to the precision equipment offered by Omer E. Robbins Co., 24800 Plymouth Rd., Detroit, Mich.
Inform-A-Gram No. A4.

Air Motor. Designed to combine in one compact unit a Lehigh cylinder, a Lehigh 4-way valve and a wide variety of valve controls, Lehigh air motors are now available in bores of 1½", 2", or 3" with any desired stroke.

Only one air connection is required to bring air to the air motor. The built-in valve can be operated either manually or by air or electricity. Further data is available from Lehigh Foundries, Inc., 1500 Lehigh Dr., Easton, Pa.
Inform-A-Gram No. A5.

A Profiling Head recently developed permits the turning of both internal and external profiles, provided the forms of said profiles allow the tool bit to be engaged in a continuous cut.

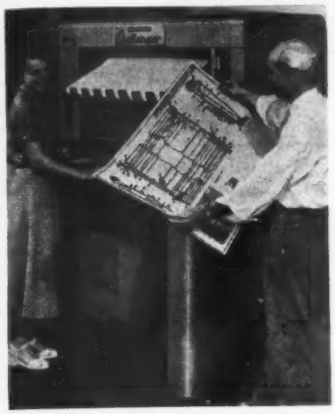


Built for heavy duty operation, the body of the attachment is drop forged and all movable parts are case hardened. Further information is available from the Alina Corp., 401 Broadway, N. Y.
Inform-A-Gram No. A6.

ON PARADE

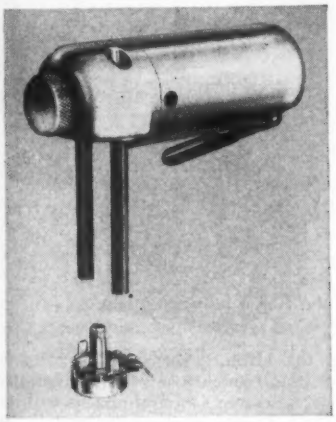
Mail FREE Inform-A-Gram Card for MORE Details.

This New Low Cost, fully automatic high production whiteprinting machine is now available from the C. F. Pease Co., 3810 N. Rockwell St., Chicago 18,



Ill. It is a one-step feed machine and features an automatic tracing separation unit. It is extremely fast in production with printer and developer synchronized to a maximum of 40 fpm.
Circle Inform-A-Gram No. A7.

Air Tool Sets Tab Mounted Controls. The Wire-Wrap Division of the Keller Tool Co., Grand Haven, Mich., has just announced its new 14K-1 "Tab-Set"



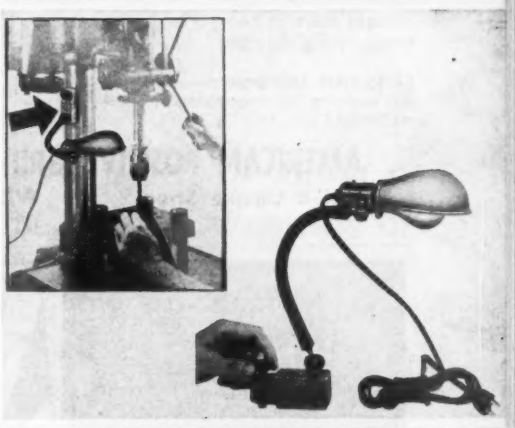
tool for mounting tab mounted controls to the chassis. It is air powered and has two spindles that rotate in opposite directions simultaneously, eliminating any reaction to the operator's hand.
Circle Inform-A-Gram No. A8.

GAGE KIT . . .

The Sheffield Corp., Dayton 1, Ohio, announces a new adjustable airebore gage kit with a 3" to 12" range of adjustment. With this kit, any size hole between 3" to 12" in diameter can be quickly and accurately inspected for size, taper, and out-of-roundness. The gage is self-centering and needs only to be rocked to ascertain the true diameter of the bore.
Inform-A-Gram No. A9.

LIGHTING UNIT . . .

This portable magnetic base lighting unit holds up to 100-watt standard bulb; mounts instantly to flat or down to ¾" round surfaces with pull of 125 lbs.; and has ball and socket flexible stem assembly that permits positioning to every possible angle in hard-to-light places. Details available from the Enco Mfg. Co., 4520 W. Fullerton Ave., Chicago 39, Ill.
Inform-A-Gram No. A10.



MILLING CUTTER . . .

An inserted solid carbide blade milling cutter with all the requirements for high production metal removal has been introduced by Millit, Inc., 49 Flint St., Rochester 8, N. Y. Close blade spacing combined with increased blade strength makes the use of exceptionally high feed rates possible with this cutter. Further details are available.
Inform-A-Gram No. A11.

PRECISION DRILLS . . .

High speed drills are being stocked in sizes of 0.01 mm apart and starting with 0.08 mm (0.003") by Louis Levin & Son, Inc., 3610 S. Broadway, Los Angeles 7, Calif. They are made with straight or spiral flutes.
Inform-A-Gram No. A12.

THE VISE WITH A
THOUSAND GRIPS

A veritable mechanical octopus that grips odd and irregular shaped parts "from ball bearings to multi-bearing shafts" with tentacles of steel.

ASSURES POSITIVE GRIP for any milling, cutting or drilling operation.

SAVES TIME AND MONEY—no more blocking and shimming odd shaped pieces for tool room machining.

UNIVERSAL APPLICATION — Can be used on any and all types of machine tools. Manual and air operated.

PRODUCTION JIG—The jaws form a mold or matrix to take identical pieces for grinding or machining, only has to be set once. Saves many dollars on small production runs.

Try it out in your own shop, see what it will do for you, in labor saving, better work in faster time. Built to last a lifetime.

WRITE FOR COMPLETE INFORMATION NOW!

AMERICAN POSITIVE GRIP VISE CORPORATION
1-E Olivine Street • Williamsett, Massachusetts

CIRCLE INFORM-A-GRAM KEY NO. 1581

Free
TRACING TEMPLATE
COVERING 263 ITEMS
IN FULL SCALE

QUARTER TURN SCREWS • SOCKET SHOULDER SCREWS • JIG FEET (three types) • FIXTURE KEYS (six sizes) • LATCH BOLTS (std. & long) SPHERICAL WASHERS • SPHERICAL FLANGED NUTS • STRAP CLAMPS (two types) • HARDENED NUTS & WASHERS • FLANGED NUTS N/C & N/F • CUT THREAD STUDS • TEE-NUTS (twelve sizes) • COUPLING NUTS • ADJUSTABLE STEP BLOCKS • STAR TYPE HAND KNOBS • HEXAGON TYPE HAND KNOBS • KNURLED HEAD SCREWS

T-NUT & STUD SETS
STEP BLOCK SETS
PUNCH PRESS SETS

Northwestern
116 HOLLIER AVE., DAYTON 3, OHIO

CIRCLE INFORM-A-GRAM KEY NO. 1582

IMPORTANT NOTICE

The Genuine MAUSER VERNIER CALIPER
IS NOW MADE OF STAINLESS STEEL THROUGHOUT
AND THE FOLLOWING IMPROVEMENTS HAVE BEEN ADDED
• HARDENED PHOSPHOR-BRONZE adjustable gib retains accuracy
• SPECIALLY LONG VERNIER to read thousandths
• 3 GRADUATIONS - 1/1000" - 1/128" 1/10 mm in back

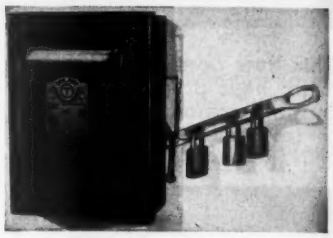
$14.75 PPD

Request illustrated folder showing complete line of MAUSER Toolmakers Calipers, Height Gages, Bevel Protractors and Tool Stands.

GEORGE SCHERR CO., Inc.
200-T Lafayette Street • New York 12, New York

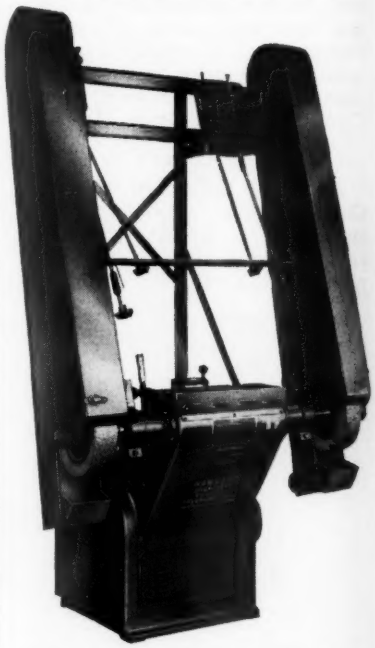
CIRCLE INFORM-A-GRAM KEY NO. 1583

A New Lockout Device for electric switch and fuse boxes has been announced by the Industrial Products Co., 2746 N. Fourth St., Philadelphia 33, Pa. Used as a safety procedure



when men are working on machines and equipment controlled by a common switch box, this unit will prevent the switch from being thrown until the last man has removed his lock. Further information is available.
Circle Inform-A-Gram No. A13.

Grinder-Polisher. Pictured here is a modern compact and space-saving Hammond grinder-polisher using abrasive belts. The mounting structure is attached to the base of the polishing lathe to which the backstands are mounted—instead of the more conventional method of mounting the backstands in the back



of the lathe. Abrasive belts up to 14' long can be used. This installation works out exceptionally well in plants where abrasive belts can be used to advantage, but limited space makes it impractical to install the backstands in back of the polishing lathe. For further information write Hammond Machinery Builders, Inc., 1631 Douglas Ave., Kalamazoo, Mich.,—or **Inform-A-Gram No. A14.**

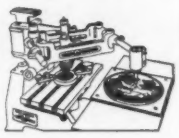
ENGRAVING,

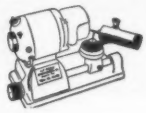
2 AND 3 DIMENSIONAL

all can be done on a

PREIS-*PANTO ENGRAVER

Model 3D-5 Three Dimensional Engraving and Die Cutting Machine. Features reversible spindle for enlarging and reducing from a model, die or sample.





Model CG Cutter Grinder for grinding, engraving and routing cutters.

Model UE Engraver for metals, plastics and other materials. Electrically marks or etches hardened steel.

*PANTOMaster Copy Type, Cutters and Collets for all types of Engraving Machines available.

PANTO *Trade Mark U. S. Pat. Off.

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H. P. PREIS ENGRAVING MACHINE CO.
647 U. S. Route 22, Hillside, N. J.

CIRCLE INFORM-A-GRAM KEY NO. 1591

MICRO-HEIGHT GAUGE
BY FAIRFIELD GAUGE CO.

NO OTHER GAUGE COMPARES FOR FAST, ACCURATE LAYOUT AND MEASURING

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Capacities to 6" when used with this Fairfield Gauge 3" Riser

The Micro-Height Gauge is a precision instrument, finished in satin chrome, which reads like a micrometer and measures from zero at base to 3" in thousandths.

Use as a scriber for fast layout, or insert dial indicator for quick, accurate inspection.

Toolmakers, Layout men, and Inspectors do better work faster with Micro-Height Gauge.

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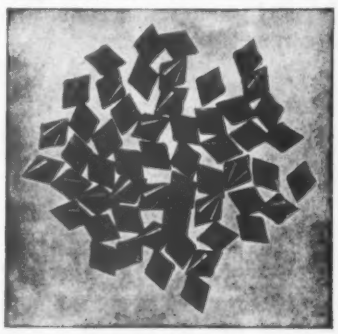
This Watts Microptic Auto-Collimator permits the plotting of any errors from a straight line or true plane to a few millionths of an inch. Its reference is a bundle of light-beams which invariably travel in a truly straight line. The instrument

is used in many prominent surface plate manufacturing plants, metal-working plants, precision industries, and government installations. Complete information, including descriptive literature and operating instructions, are available from the Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill.
Circle Inform-A-Gram No. A15.

A New Collet Fixture precision-made to fit many existing standard collets from 1/16" to 1" in diameter, has been announced by the Smith Sales Co., 193-16 99th Ave., Hollis, N. Y. The fixtures are designed for use in secondary operations of drilling, tapping, counterboring, milling, slotting, and reaming. They are easily mounted by bolting to the face plate of a lathe, the table of a drill press, or the bed of a milling machine. Collet accuracy is attained for hexagon and square parts as well as rounds.
Circle Inform-A-Gram No. A16.

For Use in Deburring & Polishing fragile parts such as injected molded plastics, small parts from zinc, brass or aluminum, jewelry parts, etc., Nylaslugs (molded nylon tumbling media have been developed by the Rampe Mfg. Co., 3320 St. Clair Ave.,



Cleveland 14, Ohio. The process used will vary with the product, but generally it consists of using Nylaslugs with an abrasive of proper roughness. After thorough rinsing the Nylaslugs are used with a polishing cream and then tumbled with clean hardwood dust. Complete details are available.
Circle Inform-A-Gram No. A17.

SUPEREAM

THE ONLY DECIMAL REAMER

No. 700 Straight Flute

No. 720 Left Hand Spiral

No. 730 30° Left Hand Spiral

No. 740 7° Right Hand Spiral

with all FLUTES ground Face and Back After Heat Treatment . . .

Preventing Clogging or Freezing of Chips for

REMARKABLE SMOOTH REAMING

All diameters are held to plus .0002 and minus .000 for close sizing. Size markings are stamped half-way up on shanks so they cannot be obliterated by drill press chucks.

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AVAILABLE IN THE ABOVE FOUR STYLES ON REQUEST. DESIGNATE BY "R" IN FRONT OF STYLE DESIRED.

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ROUTE 176 and BRADLEY ROAD
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✓✓✓ Check these 3 Comet 'TIPS' for Precision Boring, Facing and Internal Threading

MADE OF HIGH SPEED or CARBIDE

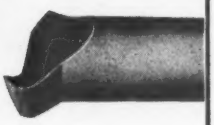
FOR HOLES FROM 1/16" UPWARD

17 DIFFERENT SIZES

✓ BORING TOOL

- FAST PERFORMANCE
- ECONOMY IN PRODUCTION
- EFFICIENT IN RESULTS

Cutting Edges are lapped for better "Bores" and faster Feeds.



✓ FACING TOOL

- CONSTANT CLEARANCE
- CONSTANT SHAPE OF CROSS SECTION
- EASY RESHARPENING
- CONVENIENT TO USE
- LONG LIFE

✓ INTERNAL THREADING TOOL

- CONSTANT SHAPE AND CLEARANCE
- EASY RESHARPENING
- CONVENIENT TO USE - LONG LIFE

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COMPARATOR SCALES

Non-breakable...accurate...designed for making quick measurements at scale on projectors and comparators without any movement of machine or work.

An unexcelled tool for use in drafting and constructing scale layouts for comparator chart use. All standard magnifications and various styles for every application.

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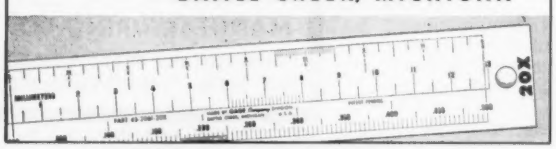
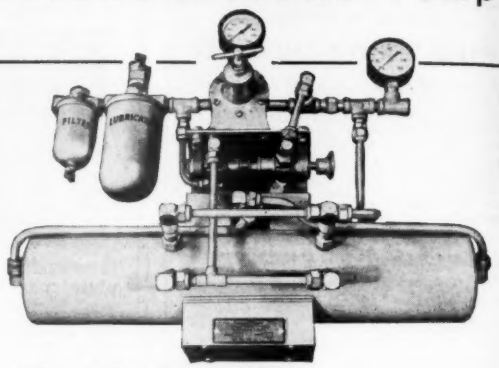
BATTLE CREEK, MICHIGAN



CIRCLE INFORM-A-GRAM KEY NO. 1603

NEW Introducing DAYTON ROGERS Pneumatic Booster Pump



- Pressure boast ratio up to 2:1
- Input air only power necessary
- Automatic operating—self-contained
- Can be regulated for any output from zero to 2 x input —holds within 5%
- Complete power package

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DAYTON ROGERS Manufacturing Company

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Buy GOLD SEAL HICKORY HANDLES

Eye end of each handle is slit for wedge, for which metal and wood wedges are included — at no extra cost. Sold only through your jobber salesman.

★ Smooth Wax Finish
★ Long and Hard Service
★ Triple Inspected
★ Made Only with Second Growth Hickory
★ Greater Strength - Less Breakage
★ Perfect Shape

Manufactured by

LA PIERRE-SAWYER HANDLE CO.

Jackson, Missouri

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KEYLESS DRILL CHUCKS

SLIP-PROOF

STRONGEST CHUCK MADE

TRY ONE

K. O. LEE CO.
ABERDEEN S D

If it's made by Lee it's a "Knock-Out"

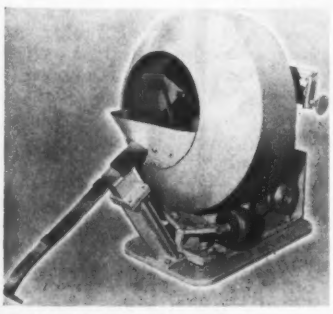
CIRCLE INFORM-A-GRAM KEY NO. 1605

A Small Parts Resistance Welder with dual heads that can be quickly and independently adjusted for pressure, time, and heat in progressive assembly work has recently been de-

veloped by Royson Engineering, Hatboro, Pa. The electrodes and holders are adjustable in all directions permitting a wide variety of setups. Additional details are available.
Circle Inform-A-Gram No. A18.

A Novel and Precise Measurement Gage is now being used in tool making and inspection departments to measure "O" ring grooves, deep holes, tapers, recesses, inside spherical radii, and out-of-round areas. It will accurately measure to 0.0005" but even closer readings may be checked, dependent upon the operator. This highly accurate gage instrument is shaped somewhat like a pistol for ease of holding and has a dial gage mounted on top calibrated in half-thousandths. Literature and complete details may be obtained by writing to Mueller Laboratory, 239 W. Maple Ave., Monrovia, Calif.
Circle Inform-A-Gram No. A19.

Tumble Hopper. The addition of the Model 400 tumble hopper to its present line or mechanical hopper feeds has been announced by the Feedall Machine and Engineering Co,. 38399 Pelton Rd., Willoughby,



Ohio. This unit is designed for feeding a variety of parts at a high feed rate and is readily adaptable to assembly presses, centerless grinders, secondary operation machines, or other high production machinery.
Circle Inform-A-Gram No. A20.

DEBURRS 400% FASTER

SAVES 40 MANHOURS PER WEEK
with
New FLASK-TYPE GLOBE TILTING TUMBLING BARREL

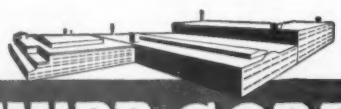
Former deburring of small precision electrical parts could be done by hand at a rate of only 40-50 pieces per hour, requiring a week for one run. One Globe Flask Type Barrel now handles the entire run of 2,500 pieces in one hour . . . a savings of 30% labor in the department. Tolerances held to .001 and .0005". These Globe Flask-Type Barrels handle steel, brass, aluminum and plastic parts with the same high output and quality finish.

Globe's new flask shell gives bigger pay-load capacity with tilting barrel control. It holds more, works faster with controlled agitation for uniform high quality parts. Low speeds for non ferrous and plastic materials.

FREE EXPERIMENTAL SERVICE

Hupp's experimental finishing laboratory will show you how to cut finishing costs. Just send samples of parts to be processed with a finished part. There's no cost or obligation.

Write Dept. F Today!



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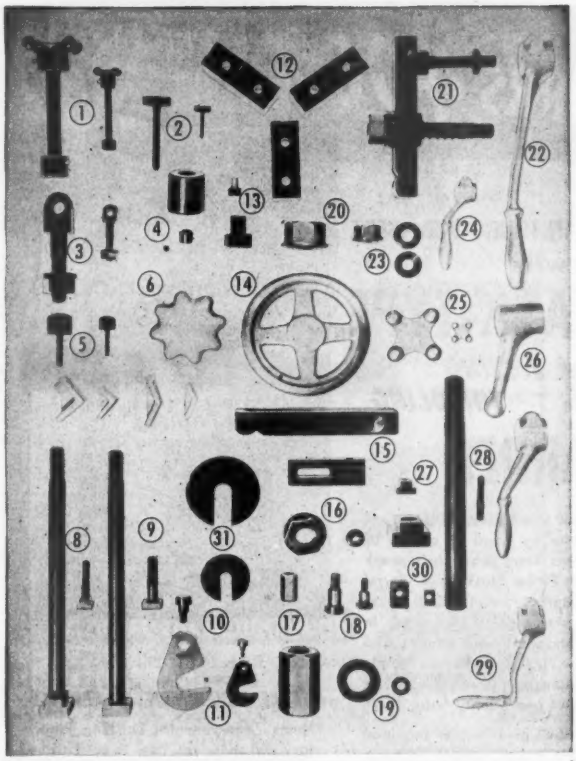

OVER 500 JERGENS STANDARDS SAVE TIME--LABOR--⅔rds THE COST

Illustrated above are just a few of the more than 500 Jergens Standard Jig & Fixture Components. One of the most complete lines in production today, mass-produced Jergens Standards save you the skilled tool and die room help necessary for the custom making of component parts in your own shop. Keyed to the photograph and listed below is a brief description of a number of these items now immediately available from stock. Write for descriptive catalog and price list.

1. Clamp Shoe Assemblies—14 sizes—alloy steel screws—hardened steel shoes with snap ring lock.
2. Thumb Screws—4 sizes—3 lengths each size.
3. Latch Screws—4 sizes—hardened.
4. Jig Rest Buttons—4 sizes—hardened—ground.
5. Quarter Turn Screws—9 sizes—soft steel.
6. Palm Grip Hand Knobs—with reamed, tapped, or square hole.
8. Tee Slot Bolts—standard sizes 3/8" to 1"—various lengths.
9. Tee Bolts—standard sizes ½" to ¾"—various lengths.
10. Shoulder Screws—for use with swing "C" washer.
11. Swing "C" Washers—4 sizes—comes with shoulder screw.
12. Blank Soft Chuck Jaws—19 standard sizes—S.A.E. 1020 Steel—in stock to fit approximately 273 master chucks at a moment's notice—special blanks made on request.
13. Rest Buttons—4 sizes—hardened—ground.
14. Hand Wheels—4 sizes 6" to 12" in diameter—aluminum alloy.
15. Strap Clamps—hard and soft—plain or with radius.
16. Flange Nuts—9 sizes—hardened.
17. Extension Nut Couplers—8 sizes—alloy steel.
18. Shoulder Screws—24 sizes—Hex head socket—160,000 to 180,000 P.S.I.
19. Plain Flat Washers—8 sizes—hardened—ground.
20. Spherical Flange Nuts—9 sizes—hardened—ground.
21. Strap Clamp Assemblies—comes with spherical flanged nut assembly or hand knob for clamping the strap.
22. & 24. Offset Handles—aluminum alloy or malleable casting.
23. Spherical Washers—hardened—ground.
25. Hand Knobs—aluminum alloy casting.
26. Clamping Levers—aluminum alloy or malleable casting.
27. Tee Nuts—14 sizes—hardened.
28. Studs—stress-proof steel.
29. Crank Handles—aluminum alloy or malleable casting.
30. Fixture Keys—(hard or soft)—ground.
31. "C" Washers—22 sizes—4, 5, and 6 diameters each size—ground.

Jergens BETTER TOOLS AT LOWER COST
TOOL SPECIALTY CO.
712 E. 163rd ST., CLEVELAND 10, OHIO

CIRCLE INFORM-A-GRAM KEY NO. 1621

HOW TO WIN ARGUMENTS

on Surface Roughness!

FREE BULLETIN LT85 tells–

★Why time is wasted by arguments about the roughness of parts produced.

★How to end such arguments FOR SURE.

★How shop men, engineers and management all gain when such arguments are settled by the Profilometer.

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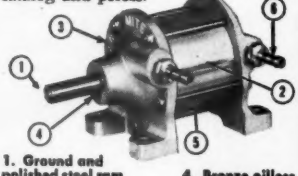
Profilometer is a registered trade mark.

MMCo **MICROMETRICAL MANUFACTURING COMPANY**
345 S. MAIN ST. ANN ARBOR 14, MICH.
CIRCLE INFORM-A-GRAM KEY NO. 1622

AIR-MITE AIR CYLINDERS

Low Cost Compact Powerful Rugged

AIR-MITE Cylinders—made in single or double acting series—in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling or lifting is required, AIR-MITE cylinders will meet your most exacting standards of dependability and long life. Write for complete catalog and prices.



1. Ground and polished steel ram
2. Brass, true-bore cylinders
3. High strength aluminum alloy cylinder heads
4. Bronze oilless ram bushing
5. Five steel tie rods
6. Brass hose stems

4 Mounting Types

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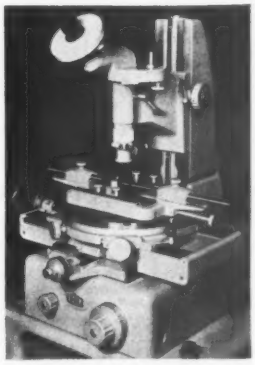
This Tap Bushing has a square broached hole to fit and drive all standard diameter taps from No. 0 to 1⅝" and pipe taps from ⅛" to 1". They come in five O.D. sizes to fit ½", ⅝", 1", 1¼", and 1½" tap holders. The bushing cuts tap breakage to a minimum. Further data available from Byco Industries, 2300 E. 31 St., Minneapolis, Minn. **Inform-A-Gram No. A21.**

Built-In Safety Features for Index Tables. New index tables being built by the Michigan Drill Head Co., Detroit 34, Mich., have such safety features as complete

hydraulic operation with a positive location from a tapered bolt; fluid-drive motor; and automatic stop. These new index tables come in four sizes: 20", 30", 42", and 60". They can be bored for any number of stations, ranging from two to 15. **Inform-A-Gram No. A22.**

A Toolmaker Microscope with extra large measuring capacity of 6" x 2.35 has been added to the Leitz line of optical measuring instruments. This new instrument provides extra capacity, not only in the measuring range, but also in diameter of rotary table, depth of throat, and in general dimensioning of the stand as well as compound stage. Catalog 8568 available from George Scherr Co., Inc., 200 Lafayette St., New York 12, tells all. **Circle No. A23.**

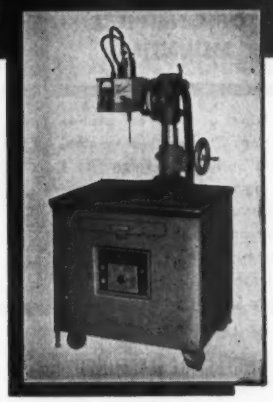


A Tiny Lubricating System especially designed for small machine elements has been developed by The Bijur Lubricating Co., Rochelle Park, N. J. Known as the "L Special", this unit brings the advantages of low-cost automatic lubrication to machines having minimum lubrication demands. It also makes it possible to eliminate the uncertainties of older "oil-can" methods in lubricating many types of small and delicate instruments. The "L Special" may be installed to discharge into passages drilled in the machine and leading into the lubrication points, or it may discharge into tubing leading to these points. Further information is available. **Circle Inform-A-Gram No. A24.**

METAL DISINTEGRATION

and what it can do for you

Remove broken taps fast without distortion
Cut any shape hole in cemented carbides
Cut dovetails in hardened dies
Cut oil holes in hardened gears without annealing



Literally hundreds of thousands of dollars are saved annually by corporations that are using Metalmasters in just tool and die repair alone.

There's a technical engineer in your area to give you an on-the-spot demonstration in your own plant at your convenience. (NOTE: It is not uncommon to pay for a Metalmaster with just one short demonstration through savings on workpieces.

There's a Metalmaster designed for your operation and priced to fit your needs. For information as to the many uses and benefits Metalmaster can offer you, write today on your company letterhead to:

Metalmaster
DIVISION OF CLINTON MACHINE COMPANY
CLINTON, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 1631

FLEXIBILITY OF SECTIONAL ASSEMBLY

RIGIDITY OF ONE-PIECE MOUNTING

CHALLENGE LAYOUT SURFACE PLATES

Precision ground or planer finished, Challenge semi-steel Layout Surface Plates provide a true, rigid surface for layout, inspection or assembly work. Plates can be grooved and keyed so that two or more can be mounted into one large complete unit. Write for new Challenge catolog.

Close up view showing how plates are bolted and keyed to insure a flat surface of unyielding strength. Available with grooving, scoring, or "T-Slots." 6" thick plates in 16 standard sizes - other sizes to order.

777

THE CHALLENGE MACHINERY CO.
Office, Factories and Show Room
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Challenge
TRADE-MARK ®

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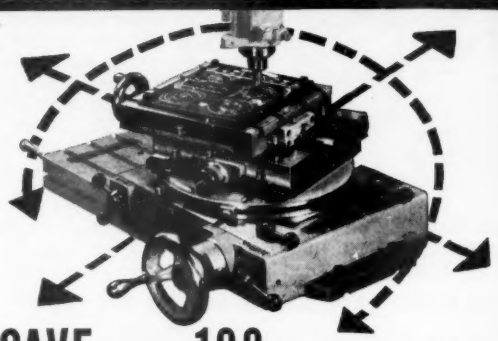
ADVANCE
CROSS-SLIDE ROTARY TABLE



SAVE up to 198 Hours or More set-up and machining time*

on Stamping Dies, Cams, Templates, Forging Dies, Patterns, Die Cast Dies, Rubber molds, Tools, Plastic molds, Jigs, Gauges, Fixtures, Models, Experimental work, Boring and Grinding jobs, Short-run production!

FITS MOST STANDARD VERTICAL MILLING MACHINES

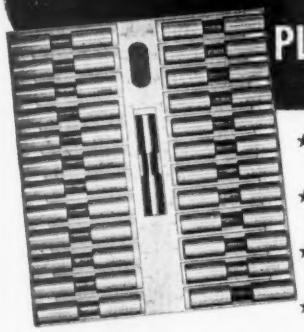
*Proved by our customers! Hours saved in comparison with time needed to do job on standard vertical milling machines not equipped with table.

WRITE FOR SPECIFICATIONS and literature showing typical jobs.

ADVANCE PRODUCTS / BENTON HARBOR, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 1642

CLOSER TOLERANCES with DELTRONIC TENTH PLUG GAUGES



★ Size variation by ten thousandths
★ Set of 25 costs approximately same as Go and No-Go gauge.
★ Available in increments of 1/64" from 1/8" to 1"
★ Hardness is Rockwell C62/C64

This new system of precision gauging provides one gauge of nominal size plus 12 gauges of increasingly larger sizes in .0001" increments and 12 gauges of decreasingly smaller sizes in increments of .0001". Each gauge is identified. It is the same size on both ends to double the life in usage.

For further information write Dept. D1.

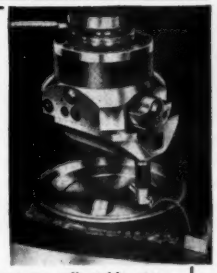
DELTRONIC CORPORATION
9010 BELLANCA AVENUE • LOS ANGELES 45, CALIF.

CIRCLE INFORM-A-GRAM KEY NO. 1643

ONE Tool
ONE Set Up

. . . for boring, facing, turning, recessing, undercutting.

MASTERHEAD
THE BORING AND FACING HEAD THAT THINKS FOR ITSELF

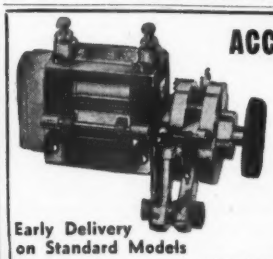


Featuring: automatic feeds, end release and return; adjustable stop; adaptable to all standard machines; highest precision; ideal for jig borers; nine models for work up to 36¼" diameter.

Send for Illustrated Literature

KARL A. NEISE 404-4th Ave., Dept. TP. New York 16, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 1644



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Models to fit:
ANY PRESS
FOR ANY JOB
FOR STOCK UP TO 12" WIDE

Early Delivery on Standard Models

"RFC" ROLL FEEDS are quality built for long, dependable service.

Write for descriptive literature TODAY

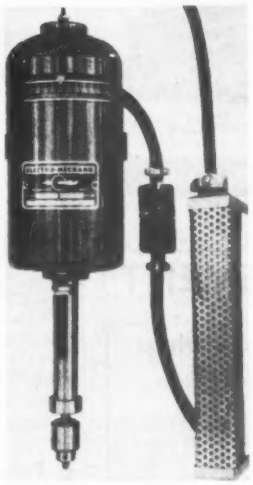
ROLL-FEEDS CORPORATION
Pawtucket, Rhode Island
An Electrix Affiliate

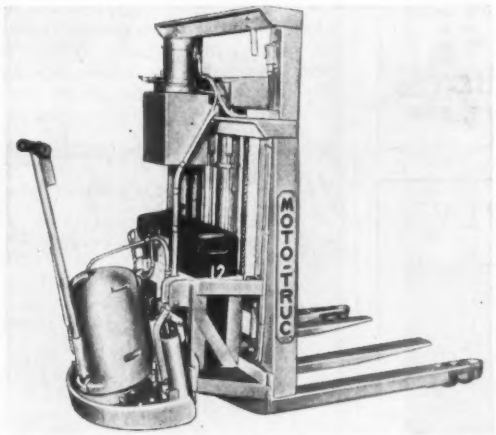
CIRCLE INFORM-A-GRAM KEY NO. 1645

Such Safety Factors as an automatic brake which holds the load even if the air supply fails, and up and down stops that automatically shut off the air, are featured in the latest air hoists produced by the Ingersoll-Rand

Co., Phillipsburg, N. J. Other features are the variable speed control; a poppet type valve throttle which prevents air leakage; and automatic lubrication which provides for long life and low maintenance. More information is available to TOOLING & PRODUCTION readers who— **Circle Inform-A-Gram No. A25.**

This High Speed Spindle Unit, complete with self-contained motor, is for use in special drilling, reaming and grinding machines. Speed ranges of 1000 to 10,000 rpm, or 2,500 to 15,000 rpm are available. An electric governor keeps the spindle speed constant whether idling or drilling. The unit can be mounted in any position. The metal cage with the unit contains a 4' cord and it should be mounted out of the way of chips. For further information write to the Electro-Mechano Co., 261 E. Erie St., Milwaukee, Wis., or— **Inform-A-Gram No. A26.**





A New "Jack Knife" action feature that eliminates lift truck "hang ups" is now available on standard outrigger Hi-Lift trucks. The repositioning of the truck frame to produce the "Jack-Knife" feature is accomplished by means of a hydraulic pump and ram unit. For full information, write to the Moto-Truc Company, 1990 East 59th St., Cleveland 3. **Inform-A-Gram No. A27.**

JIG GRINDING ACCURACY *guaranteed*

INFINITE CONTROLLED SPEEDS 30,000 TO 65,000 R. P. M.

Easily connect jig grinder to jig borer or mill

Then you can finish grind in hardened steel to "tenths" . . . jig grind dowel holes square with a ground base . . . move location of holes in hardened steel blocks . . . jig grind interchangeable holes in hardened sections . . . grind small holes with diamond impregnated mandrels . . . grind contours and relief with tungsten carbide burrs . . . grind radii in die sections . . . eliminate jig bushings in tools where close spacing is essential.

Other infinitely controlled air driven spindle applications

Place spindle on most any machine. Use it for finishing contours on hardened steel working surfaces . . . burring or milling die castings . . . routing wood contours . . . carbide milling or finishing slots . . . finishing holes in hardened steel to "tenths" . . . grinding with diamond wheels, carbide burrs, or diamond impregnated mandrels.

Advantages—10 micro finishes using carbide mills . . . 6 micro finishes using mounted points, operates at any angle . . . air driven, air cooled, overheating prevented . . . speed controlled at optimum point . . . 3⅛" long motor uses little working space . . . By controlling speed at any point you abolish need for many constant speed spindles.

For immediate quotation please state machine tool application. Get this manual of photos showing operations Vulcanaire performs.

*Dependably accurate to "tenths"

Vulcanaire

It's built by toolmakers for toolmakers.

MAJOR VULCAN SERVICES

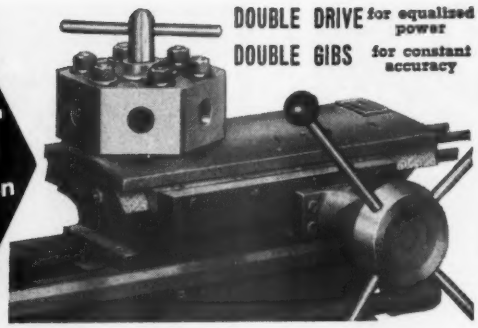
Engineering, Processing, Designing and Building, Special Tools . . . Dies . . . Special Machines . . . including the *Vulcan Hydraulics that Form, Pierce, Assemble and Size.*

VULCAN TOOL CO.

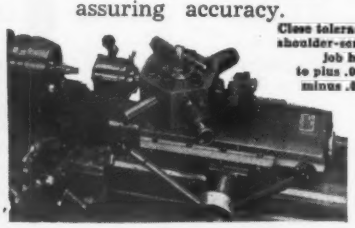
PRITZ STREET • DAYTON 10, OHIO

CIRCLE INFORM-A-GRAM KEY NO. 1651

Enco Self-Indexing HEXTURRET
For Lower Production Costs and Speedier Output



√ Custom built to fit all lathes from 9" to 18".
√ Smooth, sensitive control with Pilot wheel drive through twin gears and racks.
√ All bearing surfaces hand scraped.
√ All parts of indexing mechanism hardened, assuring accuracy.



Manufacturers of the most complete line of HEXTURRET BED TURRETS, TURRET TOOL POSTS, and TAILSTOCK TURRETS in the country.

ENCO Manufacturing Co., Dept. 7104
4524 W. FULLERTON AVE., CHICAGO 39, ILL.
SEND FOR CATALOG No. 53
Reasonable Deliveries

CIRCLE INFORM-A-GRAM KEY NO. 1661

BUSHING BONDING CEMENT

For Retaining Drill Jig Bushings
Use B-K 7 # CEMENT

No distortion of the jig plate or misalignment of the hole pattern. Eliminates lapping of press fit bushings after assembly. Not affected by drilling heat. Bushings can be retained in steel, aluminum or fiberglas jigs. Easily applied by untrained personnel. Especially recommended for use in "master tooling" operations.

SHERIDAN PRODUCTS
1054 E. Hyde Park Blvd., Inglewood 3, Calif.

CIRCLE INFORM-A-GRAM KEY NO. 1662

STOP DUSTS INSTANTLY
with
DUSTKOP

Available from stock of 22 standard models.

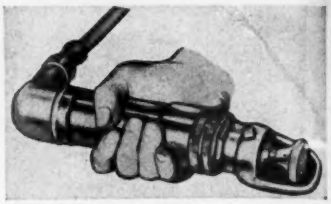
300 cfm to 10,000 cfm

Ask for Catalog 605-2. Describe dust problem for recommendation by return mail—No Obligations.

AGET-DETROIT CO.
213 Main St., Ann Arbor, Michigan

CIRCLE INFORM-A-GRAM KEY NO. 1663

Adjustable Impact Control. A turn of a baffle ring regulates the impact-force of the Appton air hammer from a gentle nudge for delicate work, to a smashing blow for brief, heavy

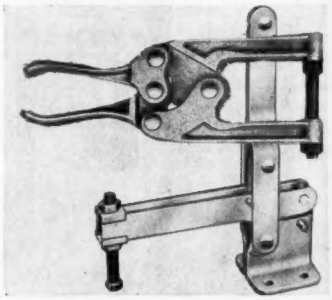


applications. Over 40 different accessory tools are available—for hammering, drilling, chipping, cutting or any other air-hammer application. For further information write to E. V. Nielson, Inc., 129 Broad St., Stamford, Conn., or— **Circle No. A28.**

Precision Soldering in the production of meters, relays, printed circuits, cable assemblies, electronic tubes, terminal boards, A. N. connectors, aircraft and electronic parts,

etc., can be had with the "Localized Heating" soldering unit. Important feature data and other information on the unit are available from Vemaline Products Co., P. O. 222, Hawthorne, N. J.
Circle Inform-A-Gram No. A29.

Frustration caused by magnetic attraction and corrosion that attend the use of most toggle clamps and pliers while spot welding aluminum or working in proximity to acids has been eliminated by a new type toggle clamp and toggle pliers devel-



oped by the Lapeer Mfg. Co., Lapeer, Mich. The clamps are made from non-magnetic stainless steel and the portable toggle pliers are forged from non-magnetic K-Monel (stronger than steel). Both are available in a wide range of sizes and types.
Circle Inform-A-Gram No. A30.

NOW

LOW COST ALUMINUM SHELLS

IN SIZES 3/16 TO 3/4 IN. DIA.

Produced by the New Economical Process

IMPACT EXTRUSION

SEND SPECS. OR SAMPLES FOR QUOTATION

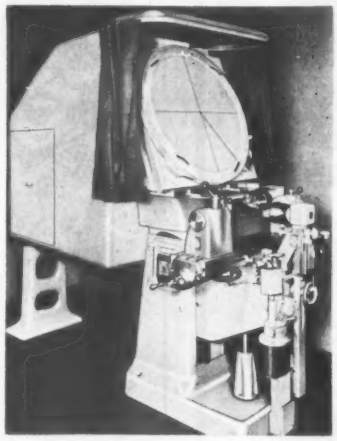
PODLIN TOOL CO.

11849 Franklin Ave. • Bensenville, Ill.

SUBURBAN CHICAGO

CIRCLE INFORM-A-GRAM KEY NO. 1671

For Inspecting Heavy Parts a special 30" screen optical comparator has been produced by the Jones & Lamson Co., Springfield, Vt. Built to rigid machine tool standards with a milling machine type base and



table, this comparator inspects heavy pieces such as aircraft propellor blades, gang milling cutters and saws, blanking, forming, coining, rolling and seaming dies, plus castings and other parts that require extreme close-tolerance inspection.
Circle Inform-A-Gram No. A31.

Buy DURANT

PRESS ROOM EQUIPMENT

WIRE STRAIGHTENERS
Takes round or flat wire and tubing. Rolls adjustable by means of socket set screw. For use with automatic Slide, Roll or Hitch Feeds. Units available with 5, 7, 9 or 11 grooved rolls.

MOTOR DRIVEN STOCK STRAIGHTENERS
For all thin materials. Entering rolls power driven; top rolls are individually adjustable for stock thickness. Available in eight sizes.

SWEEP GUARDS
A positive safety guard on power presses. Easily installed. Downward motion of ram removes operator's hands. Rugged—withstands jarring impact of press. Needle bearings in guard housings assures long life.

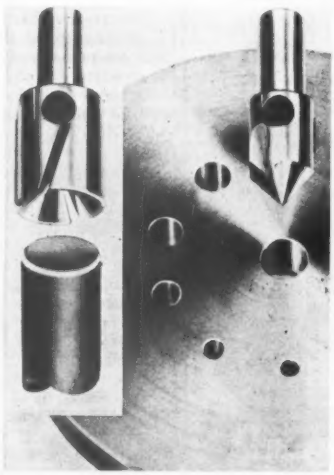
Write Now for new catalog showing prices and complete line of Equipment.

DURANT Tool Supply Co.

136 SOUTH WATER STREET, PROVIDENCE 3, R. I.

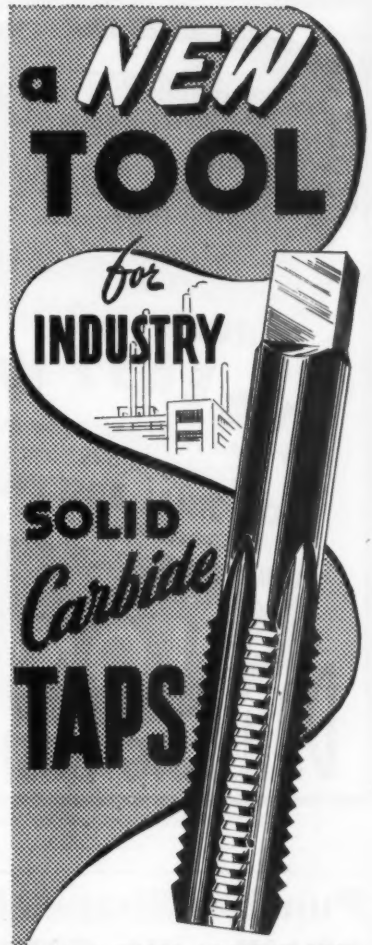
CIRCLE INFORM-A-GRAM KEY NO. 1672

Two New Companion Tools, Nobursink and Noburod, utilizing an entirely new principle for the fast, efficient and economical deburring and chamfering of O.D.'s and I.D.'s have recently been added to the line



of deburring tools manufactured by Nobur Mfg. Co., 717 N. Victory Blvd., Burbank, Calif. Both tools will work equally well on all metals. Range of application extends from less than 1/16" hole size up to body diameter. Tools are furnished with 90° included angle for 45° chamfer, made from H.S.S., carefully heat treated, and precision ground.
Circle Inform-A-Gram No. A32.

a NEW TOOL for INDUSTRY



SOLID Carbide TAPS

MANY TIMES LONGER LIFE IN

- ALUMINUM
- CERAMICS
- PLASTICS
- COPPER
- ZAMACK
- POWERED METALS
- FIBRE
- MAGNESIUM
- LEAD
- CAST IRON
- BRONZE
- LAMINATED & FIBRE GLASS

CARBIDE TAPS provide many times the wear of steel taps, when properly used, on recommended materials. They SAVE in many ways . . . on perishable tool costs . . . in hours of time by cutting "down" time on production runs . . . in gauging 100% sharpening time . . . by saving repetitive set-ups and spoilage of parts.

Not Recommended for Use on Steel

FROM STOCK OR MADE TO SPECIFICATIONS

WALTER T. COLE CO.

CARBIDE THREADING SPECIALTIES

3217 E. Washington St. Phoenix, Ariz.

CIRCLE INFORM-A-GRAM KEY NO. 1673

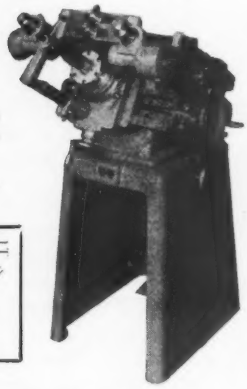
CIRCLE INFORM-A-GRAM KEY NO. 1681

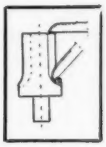
CIRCLE INFORM-A-GRAM KEY NO. 1682

Punches Shaped from the SOLID with OTTMANN Punch Shaper

FEATURES:

1. No holder plates required.
2. Simple work mounting.
3. No re-setting — Work can be adjusted to any position of tool.
4. Forms shaped accurate. Parallel and true.





5. Minimum hand work.
6. Convenient, simple operation. Uses standard shaping tools.

Write for Literature

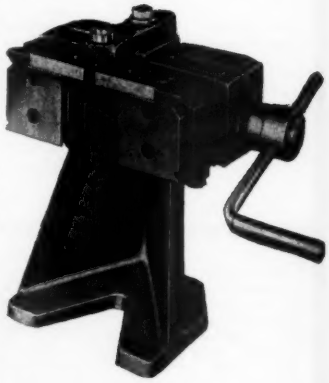
CEDAR-WEST TOOL CO., INC.

90 WEST ST. NEW YORK 6. N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 1683

"JOHN'S" UNIVERSAL DRILL JIG

Minimizes Tooling - - - Increases Production



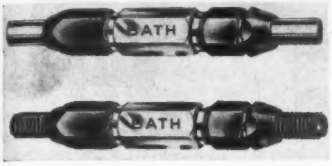
For cross drilling or end drilling round, hexagon, or square stock or standard or odd shaped castings from ⅛" to 8" O.D. the self-centering "JOHN'S" Drill Jig cuts tooling and production costs to minimum for 10 to 100,000 pieces. Standard removable slip fit bushings and holders available to drill center or mean off-center holes from #60 to 1-1/32" drill. Special bushing holders for multi-drill operations easily tooled. The self-centering action will hold within .0015" or better regardless of jig wear or piece part O.D. variation. Ideal for holding rough castings. Working jaws that hold part, and bushing holders, can be doweled to provide any number of permanent drill jigs from one jig. Bases available for mounting jigs from 1" to 18" off working surface. Handles reversible; can be put on either side of jig. Can also be used with floating jaws for outside location points. Jigs available in three sizes 6", 8", 14", jaw openings 2½", 3¼", 7½". For information on hundreds of uses for jig or tooling recommendations for specific job, write:

HEUSER MANUFACTURING CO.

1638 N. Paulina St., Chicago 22, Ill.

CIRCLE INFORM-A-GRAM KEY NO. 1684

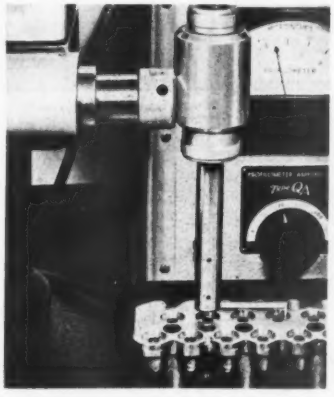
Reversible Gages. Just added to the Bath line of ground thread taps and regular thread gages, is a new line of thread and cylindrical reversible gages designed to cut gaging



costs. They are made from selected steel and have a luster-lapped finish. They are also adjustable for use as depth gages and have "go" and "no-go" color identification. Complete data is available from John Bath & Co., Inc., 20 Grafton St., Worcester 8, Mass. **Inform-A-Gram No. A33.**

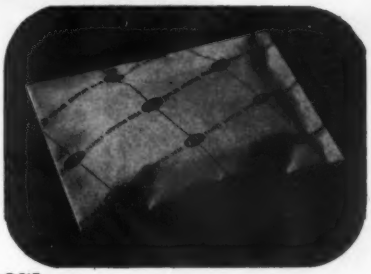
A New All-Pneumatic Impact Press originally developed for impression marking of metal parts, but extended for work in other fields, has been brought out by the Heidrich-Nourse Co., 631 E. Third St., Los Angeles 13, Calif. Principal features of this unit are complete uniformity of impact force on work pieces varying considerably in thickness; operator safety; and speed up to 10,000 complete cycles per hour. The press is useful on a wide range of impact operations, either one-shot or progressive, including impression marking, stamping, staking, swaging, upsetting, and riveting.
Circle Inform-A-Gram No. A34.

For Measuring Surface Roughness across the bottom of flat-bottom grooves and soils to ¼" depth and behind shoulders to ¼" height, a Profilometer Type GC tracer has been developed by the Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor,



Mich. When measuring crosswise, this instrument permits 1/16" length of trace in slots of 5/32" width, and greater length of trace in wider slots. It measures lengthwise in slots as narrow as 5/64". Full details and specifications are given in Bulletin LT93, which is available by writing to the company, or just—
Circle Inform-A-Gram No. A35.

WRITE FOR FREE SAMPLES
of
JIFFY PADDED SHIPPING BAGS



- *You've got to see how easy it is to pack for shipment in a Jiffy Bag.*
- *You've got to feel the thick cushioning of a Jiffy Bag to realize how well it protects your product in shipment.*
- *You've got to compare the time it takes to pack in a Jiffy Bag with your present packing method.*
- *You've got to analyze the cost of using Jiffy Bag and the other packaging materials.*
- *You've got to translate into dollars and cents the savings in time, labor and material to see how economical it is to use Jiffy Bags.*

To do all this—you must have a Jiffy Bag to make your own test shipment.

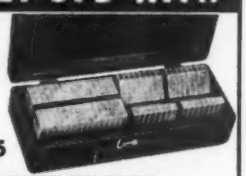
SEND FOR FREE SAMPLES TODAY!

JIFFY MANUFACTURING COMPANY
376 FLORENCE AVENUE • HILLSIDE, N. J.

CIRCLE INFORM-A-GRAM KEY NO. 1691

SPEED SURFACE GRINDING SET-UPS WITH

MAGNE-BLOX
LAMINATED PARALLELS AND V-BLOCKS
Save Your Magnetic Chucks
Eliminate Clamps
Eliminate Holding Devices



- Grind Work Square
- Grind Work Parallel
- Hold Round Pieces

UNIVERSAL SET IN CASE **$22.25**
WRITE FOR ILLUSTRATED FOLDER

GEO. SCHERR CO., INC. 200-T LAFAYETTE STREET • NEW YORK 12, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 1692

Specify DESTACO SHIM STOCK

Made from selected steel or brass, rolled to precision limits, oiled to resist stain and rust, free from burrs. Twelve assorted thicknesses .001" to .015", sheets 6" x 12", coils 120", identified every 6" by thickness and amount remaining on roll.

DESTACO DETROIT STAMPING COMPANY
344 MIDLAND AVENUE DETROIT 3, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 1693

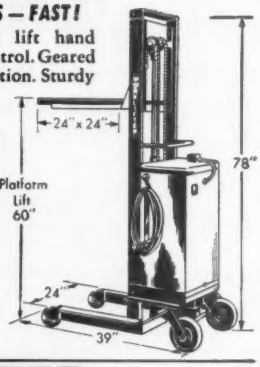
ECONOMY LIFTERS

Sturdy Structural Steel Frame Engineered for Extra Stability and Strength

WORKLIFTER

STACKS 1000 LB. LOADS — FAST!

Battery powered, hydraulic lift hand truck. Push button remote control. Geared pump for smooth, quiet operation. Sturdy structural steel frame. 12 volts (two six volt batteries) lifts loads fast. Built-in, 8 amp/hr battery charger. Power shut-off to prevent excessive over-load. Roller bearing, solid hard rubber wheels.



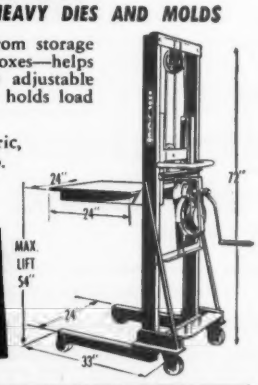
Standard models priced from **$695.00.** Special models, for handling pallets, drums, and many other special applications.

SHOPLIFTER

LIFTS-MOVES-SEPARATES HEAVY DIES AND MOLDS

Safely handles heavy dies from storage rack to press—lifts barrels, boxes—helps load trucks—or as a handy adjustable shop table. Automatic brake holds load at any height.

Four models, hand and electric, priced from **$183.60** and up. Capacities 500 lbs. to 2000 lbs.



Write for new Catalog No. 54. Contains complete information on all models of Shoplifters, Worklifters, and elevating tables.

ELEVATING TABLE

ADJUSTABLE HEIGHT — 2000 LBS. CAPACITY

For feeding sheet stock, supporting fabricated frames, handling heavy dies or as a portable work bench.

Self-locking worm and screw elevating mechanism holds work at any height without danger of falling.

Table dimensions 24" x 36". Height adjustable between 24" minimum and 42" maximum. Foot operated floor lock holds table stationary when not in use.

Price $210.80 f.o.b. Chicago
Service representatives in all industrial areas.

ECONOMY ENGINEERING CO., 4509 W. LAKE ST. Chicago 24, Ill.
ESTABLISHED 1901

CIRCLE INFORM-A-GRAM KEY NO. 1701

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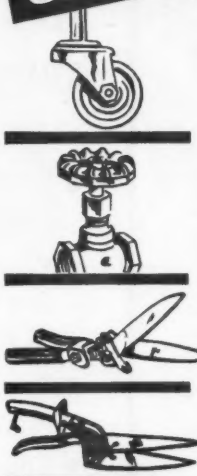
use this special, thin GRIPCO JAM NUT



to get a positive lock on bolts subjected to shearing stresses where the strength of a full nut is not required. The thin GRIPCO Jam Nut locks without the use of lock washers or other parts. The nut itself does the WHOLE job—so shorter bolts can be used. Applicable on such products as valve handles, casters, garden and pruning shears, hedge clippers, sickle bars, etc. GRIPCO JAM NUTS are manufactured in the new Unified Finish and Heavy Series (Hexagon). Furnished in standard full and jam dimensions, in steel, brass and aluminum. *Write for samples and full particulars*

GRIPCO PRODUCTS INCLUDE:
Gripco Lock Nuts, New Gripco "Clinch" Nuts, Gripco Hi-Nuts, Gripco Pilot-Projection and Countersunk Weld Nuts with or without Gripco locking feature.

III

GRIP NUT COMPANY

"after 50 years still holding strong"

308-W S. MICHIGAN AVE., CHICAGO 4, ILL.

CIRCLE INFORM-A-GRAM KEY NO. 1702

World's Hardest Metal
TOOLS
BLADES
ROLLS
BAR STOCK
DIES
Many times more durable than steel, Talide Metal adds years of life to the wearing edges of tools, dies, machinery and equipment.
Hard as a diamond and almost indestructible, it triples output per man and per machine.
For good service and recommendations for improving any cutting, drawing or wear-resistant application, send particulars to Metal Carbides Corp., Youngstown 7, Ohio. Write for Catalog No. 54-G
METAL CARBIDES CORPORATION
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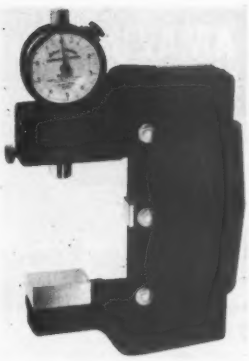
SINTERED CARBIDES · HOT PRESSED CARBIDES
HEAVY METAL · CERMETS · HIGH TEMPERATURE ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

CIRCLE INFORM-A-GRAM KEY NO. 1703

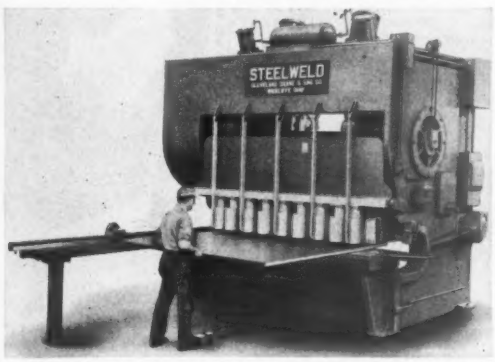
Snap Gage. Here is a true multi-purpose gage that may also be used with a bench stand. It is fully adjustable with a light, ruggedly constructed frame. Its gaging contact buttons and anvils permit positive gaging. The gaging contacts can quickly be removed and replaced with other types for varied gaging requirements. For further data write to Reliant Industries, 4947 Firestone Blvd., South Gate, Calif., or— **No. A36.**



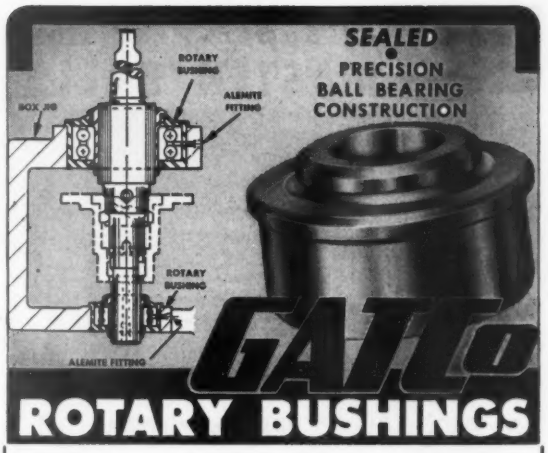
A New Tool for production turret lathe work which provides accurate and identical center drilling throughout production runs has been developed. The tool, called the Identi-Center, is a combination rotary stock stop and center drill holder. When measuring off stock, there is no need to shut off the machine, since the hardened cap of the tool rotates on a ball bearing when the stock meets it. For additional data write the Schultz Mfg. Co., 3444 Orange Ave., Dept. N-1, Cleveland 15, Ohio,— **Inform-A-Gram No. A37.**

A Special Releasing Driver, capable of reducing tap breakage drastically, has been designed with a spring-loaded shank to accommodate lead screw tapping, according to Scully-Jones and Co., 1913 S. Rockwell St.,

Chicago 8, Ill. The adjustable-torque clutch mechanism operates on Scully-Jones' new "safe-torque" principle, a method that assures complete release and eliminates objectionable friction, heat, wear, and impact action. **Circle Inform-A-Gram No. A38.**



A Steelweld Shear which will cut heavier plate than any previously built, has just been completed by The Cleveland Crane & Engineering Co., Wickliffe, Ohio. This machine is designed for production shearing of steel plate in sizes up to 8' long and 1½" thick. Further information is available. **Circle Inform-A-Gram No. A39.**



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CORE DRILLING
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The inner race of the GATCO bushing rotates with the tool, piloting the tool accurately below or above the work—or both.

Eliminates expensive tool construction—Reduces tool wear —Prevents seizure and pilot breakage—Especially adapted where precision is required.

Write for full information and prices

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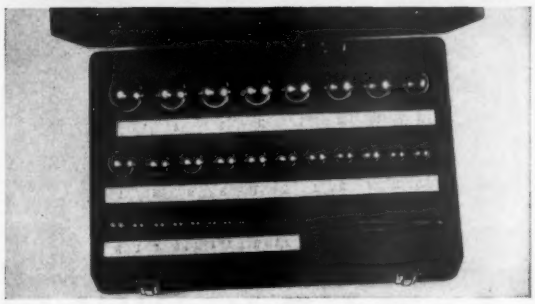
Telephone PLYMOUTH 1472

CIRCLE INFORM-A-GRAM KEY NO. 1711

SETS of Super-Precision MASTER BALLS



For GAGE BLOCK ACCURACY at NOMINAL COST

- **IDEAL FOR USE** in setting comparator gages — as masters and measuring standards.
- **SUPER-ACCURATE** — to 0.000010".
- **TWO SETS,** 1/16" to 1" diameter: **Set No. 16** — 16 balls in 1/16" increments. **Set No. 32** (shown above) — 31 balls in 1/32" increments.

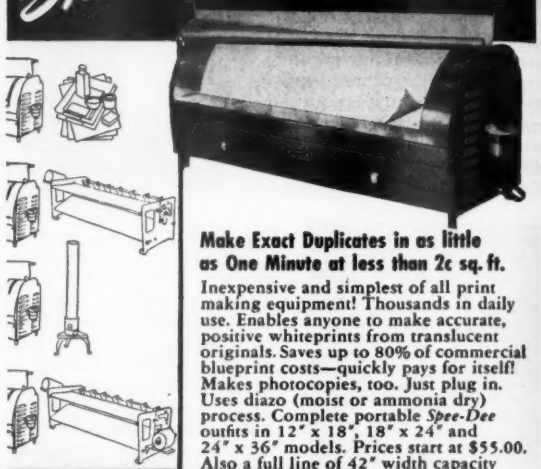
EVERY shop, tool room and gage room will find many uses for these ITI Master Balls. *Write for free bulletin!*

INDUSTRIAL TECTONICS, Inc. ANN ARBOR 7, MICH.

ITI PRECISION BALLS
All Materials — All Sizes
In Large or Small Quantities

CIRCLE INFORM-A-GRAM KEY NO. 1721

AMAZING! the Time and Money Saved WITH *Spee-Dee* WHITEPRINT OUTFITS



Make Exact Duplicates in as little as One Minute at less than 2c sq. ft.

Inexpensive and simplest of all print making equipment! Thousands in daily use. Enables anyone to make accurate, positive whiteprints from translucent originals. Saves up to 80% of commercial blueprint costs—quickly pays for itself! Makes photocopies, too. Just plug in. Uses diazo (moist or ammonia dry) process. Complete portable *Spee-Dee* outfits in 12" x 18", 18" x 24" and 24" x 36" models. Prices start at $55.00. Also a full line of 42" width capacity volume production whiteprinters at moderate prices.

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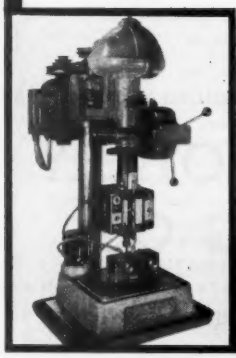
CIRCLE INFORM-A-GRAM KEY NO. 1722

Commander **LĒAD-MATIC** *Tapper*

Automatic Tapper with Lead Screw
FOR HIGH PRODUCTION PRECISION TAPPING

- **Precision Ground Lead Screws Assure Finest Threads**
- **Electrically Controlled Cycle or Jog Tapping Action**
- **Hand, Foot or Fixture Switch Control**
- **Easily Adapted to Any Drill Press**
- **Range #0 to ¾"**



Built for high production tapping . . . precision or otherwise, the Commander Lēad-Matic Tapper makes any drill press a precision tapping unit, even with inexperienced operators. Electric control of Cycle or Jog tapping action provides versatility to handle any job . . . automatic tap reversal eliminates drill press motor reversing and speeds tapping. Compact, ruggedly built, easy to operate, the Commander Lēad-Matic Tapper will cut your tapping costs and reduce rejects to a minimum.

Write for illustrated circular and name of nearest Distributor.

Commander MFG. CO.
4728 W. KINZIE ST. • CHICAGO
PRODUCT OF COMMANDER
BUILDER OF PRODUCTION TOOLS

CIRCLE INFORM-A-GRAM KEY NO. 1723

LIFT HEAVIER LOADS SAFELY WITH A FROOM

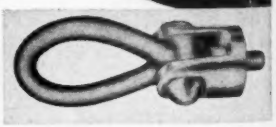
load centering EYE BOLT

More than an eye bolt... a necessary tool for all shops. Perfect load centering action aligns the load every time. The strain on bolt threads, which causes ordinary eye bolts to break off, is eliminated. Heavy objects can be lifted safely . . . moved faster ...subjected to intermittent jerks and strains without fear of eye bolt shearing off.

Protect your valuable machinery, dies tools, etc., with the safer, longer lasting Froom Load-Centering Eye Bolt. They are made from high grade steel having ductility and toughness far greater than commercial steel. Thousands in use in all industries. Prompt Delivery on Stock Sizes.

½" to ⅝"—$11.75 each
¾"—$13.50 each
⅞" to 1"—$23.50 each
Prices F.O.B. Los Angeles

Special size on quotation.
When ordering, specify amount and bolt thread size.

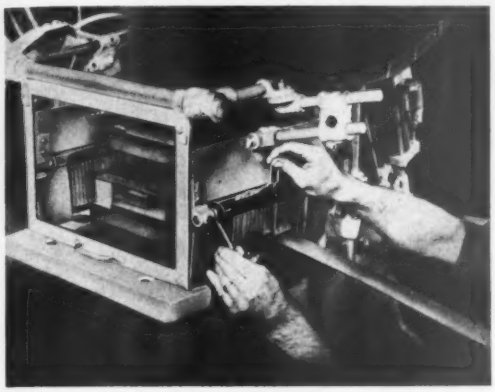


R. H. FROOM & COMPANY

1825 WEST 169TH STREET — GARDENA, CALIFORNIA

CIRCLE INFORM-A-GRAM KEY NO. 1724

Punch Press Safety. Research in further protection for punch press operators has resulted in the development of an air controlled die enclosure. This device is for punch presses limited to primary operations. The enclosure features complete safety, faster setup, easier die change, reduced fatigue, and unobstructed view. The



strong, transparent window is quickly opened to allow fast, easy die changes or to adjust stock. While the window is opened, the press cannot be tripped. The illustration shows how the adjustable finger side shields can be set to envelop stock and die clamps. The device is a product of American Allsafe Co., Inc., Buffalo, N. Y. **Circle Inform-A-Gram No. A40.**

Custom Die Cut Washers in an additional line have been announced by the Dayton Rogers Mfg. Co., 2824 13th Ave. S., Minneapolis 7, Minn. This is contract metal stamping work on which tool costs are at a minimum for short runs. Various types of thrust washers, with special OD's and ID's, from such materials as bronze bakelite, brass, and any type of alloy sheet can be produced in sizes from ⅛" to 20", with maximum blanking pressure of 295 tons. Further information is available. **Circle Inform-A-Gram No. A41.**

A Unique Design in high frequency induction heating equipment has been announced by Electric Arc Inc., 152 Jelliff Ave., Newark, N. J. Called the Kilotron, Models K400 10C and K400 20C, the units combine both current generator and work table in a single cabinet. Rated out-

puts are a full 10 to 20KW and the units are rated for continuous duty. The salient feature of the console cabinet design is the large and unobstructed 33" x 100" work table which forms the top of the generator cabinet. All you have to do to get further information is— **Circle Inform-A-Gram No. A42.**

HIGHER SPEEDS/
FASTER GRINDING/

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AIR GRINDERS

Model JA
50,000 R.P.M.
$42.00
IN U.S.A.

Weight 12 ounces; length 6¾ inches; chuck size ⅛ inch. Wheel guard removed for better illustration.

The RPM's stay up while grinding . . . not only when the grinder runs idle. That means better work—longer wheel life.

High speed grinding with small wheels was a Madison-Kipp development of the late twenties. It was born out of a pressing need in our tool room. Because tool room grinding problems are universal, we believe it will pay you to utilize Kipp grinders in your tool room as generally as we do in our own.

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CIRCLE INFORM-A-GRAM KEY NO. 1731

PRECISE
hole location,
easy contour
inspection with
new machine
tool microscope

Any machine shop, large or small, can save time and money on milling and boring work with the new Perkin-Elmer Model 11 Machine Tool Microscope. For hole location, its wide field of view (¼") or 30x magnification makes it possible to gage accurately to a ten thousandth—*at a glance.*

Mount the Model 11 on an offset bracket or directly in the spindle—it will fit nearly any machine tool. When offset it can be used for transferring hole locations from template to workpiece. The image always appears erect and moves in the same direction as the work, making it ideal for checking contours, slots, surface conditions. The Model 11 Microscope is compact, sturdy, rugged—designed for long life, accurate service.

Write today for complete details.

THE PERKIN-ELMER CORPORATION NORWALK, CONNECTICUT

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REID QUALITY TOOL-ROOM ACCESSORIES AT MODERATE PRICES!

CAST IRON KNOBS

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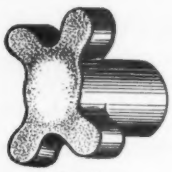
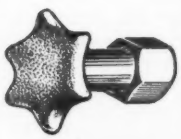


PRONG



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With Wrench Hexagon

Made in above three types and a wide variety of sizes. Designed to improve appearance of product. Well proportioned with eye appeal. Made of fine grain cast iron. Smooth finish. No sharp edges. Can be supplied drilled and tapped or drilled and reamed when desired. Low prices.

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Get our low prices for plastic and steel ball handles, machine handles, compression springs, etc.

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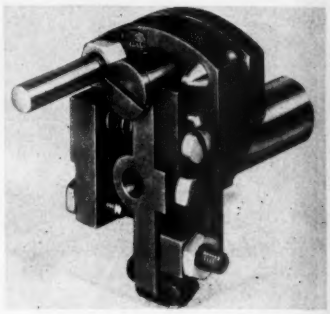
Stops Losses making Dies and Templates

Popular package 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead
THE DYKEM COMPANY
2303L North 11th St. • St. Louis 6, Mo.

CIRCLE INFORM-A-GRAM KEY NO. 1743

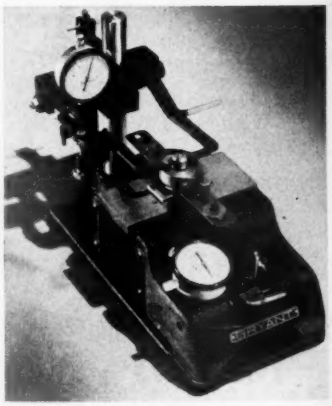
A New Recessing Tool with radial action has just been made available for automatic screw machines by the American Cam Co., Bloomfield, Conn. The Amcan Model B recessing tool shown is cam actuated by the forward motion of the turret,



thus eliminating the time usually required for the cross-slide to actuate the tool. The new tool will perform either radial recessing, form recessing, or back end chamfering without a cross slide, or swing recessing from a cross slide without changes or adaptations.
Circle Inform-A-Gram No. A43.

Gearless Drill Heads. A new 800 Series has been added to the line of standard gearless drill heads made by Zagar Tool, Inc., 2400 Lakeland Blvd., Cleveland 23, Ohio. The new drill heads have spindles up to 2½" in diameter to drill holes up to 1½" in diameter. A major advantage of these drill heads is they can drill holes as close as the sum of any two hole diameters; e.g., 1½" and ½" holes can be spaced as close as 2".
Circle Inform-A-Gram No. A44.

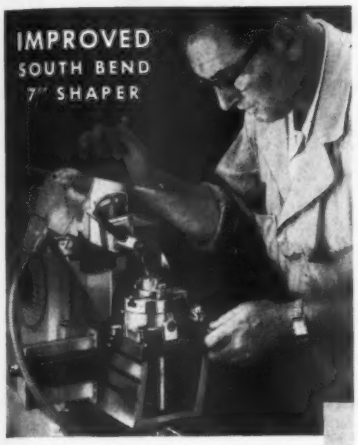
A New Bench Gage. Model 21, for the inspection of internal and external threads has been introduced by the Bryant Chucking Grinder Co., Springfield, Vt. The gage provides an accurate means of checking threads



in all tolerance classes and in sizes ranging from 5/16" to 5" diameter for internal threads and No. 8 to 5" diameter for external threads. For detailed information write for Gage Bulletin No. 21, or—**Circle No. A45.**

2 Top Values

for Small Work



Only 7" bench shaper with pressure lubrication of ram dovetail bearings, bull gear teeth and crank pin slide bearings—keeps wear to a minimum, helps absorb shock of intermittent cuts. This precision shaper has speed, accuracy and handling ease to produce more and better work at lower cost. Write for Catalog 5417. Factory price $551, less motor.

These popular lathes offer maximum value for your equipment dollars. Their quality and construction will give long years of dependable, efficient service on close-tolerance machining of small parts. Factory prices from $211, less electrical equipment. Write for Catalog 5432. 85 other models and sizes to choose from to meet your needs.

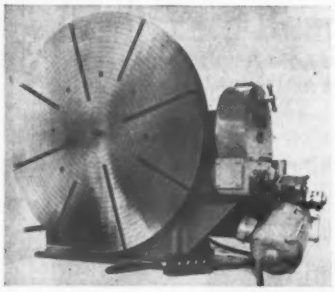
Compared with our costs
OUR PRICES ARE LOWER
than they were back in 1941
WAGES UP 150%
MATERIALS UP 135%
PRICES UP 4%
Prices are closely tied to costs. Costs are still rising. Buy now before increased costs necessitate higher prices.

SOUTH BEND LATHE
SOUTH BEND 22, INDIANA

CIRCLE INFORM-A-GRAM KEY NO. 1751

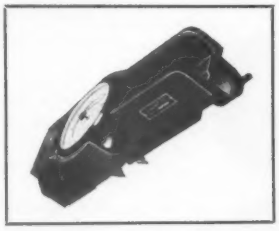
Vertical Turret Lathe. The Man-Au-Trol vertical turret lathe is fundamentally a vertical turret lathe embodying new principles of control and operation. The machine provides two manufacturing methods because it can be changed from automatic to manual operation. Complete details are contained in an illustrated brochure available from The Bullard Co., Bridgeport 2, Conn. **Circle Inform-A-Gram No. A46.**

Many Valuable Improvements have been made to broaden the applications of the Rotab, the modern new device that is calibrated for movement in all planes, to facilitate the numerous machining and the checking of radial and angular operations. One of the new features



is an optical micrometer with glass vernier reticle which permits direct reading to 5 seconds of an arc on a special graduated ring with clockwise and counter-clockwise markings from 0° to 360°. Further information is available from the Machine Products Corp., 6777 E. McNichols Rd., Detroit 12, Mich. **Circle Inform-A-Gram No. A47.**

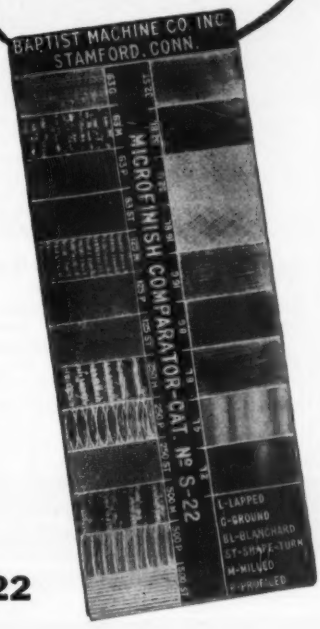
Spacing Comparator. A new low cost portable spacing comparator that can be operated by both skilled and unskilled workers has been placed on the market by the Jerpbak-Bayless Co., Solon Rd., Solon, Ohio. The unit accurately checks spacing on flat and circular thread rolling dies;



thread chasers; circular and flat form tools; wheel crusher rolls; gear racks; and broaches to within 0.0001". It may also be used to check spacing on aircraft parts such as turbine blades and may be used to check location of forms from their locating face surface. As a portable lead comparator, the unit is ideal for inspection use on all threaded products. **Circle Inform-A-Gram No. A48.**

NOW!

DETERMINE SURFACE FINISH *QUICKLY, ACCURATELY!*



S-22

MICROFINISH COMPARATOR

Men responsible for finish, specify and control roughness with Electroformed pocket Comparators — the only inexpensive, uniform system of comparison.

22 precision surfaces to A.S.A. Standard B46.2

- **Purchasing**
- **Engineering**
- **Inspection**
- **Shop**
- **Quality-Control**

Save time, reduce costly overfinish.

- **Made of Corrosion Resistant nickel.**
- **Convenient.**
- **Complete with leather case.**

Write Dept. TP for literature and prices now.

BAPTIST MACHINE CO
36 LUDLOW STREET
STAMFORD, CONN.

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Durably made of quality stock . . . simple and easy to attach . . . can be fitted to any die in 10 to 15 minutes. Adaptable to blanking, progressive or compound dies and can be used on strippers 5/16 inch thick and up. Works well on either right or left hand feeds—or with light or heavy material. Provides long, trouble-free performance.

Pays for itself after a few short runs

Automatic Stop individually packed with Trip Spring and Mounting Screws..... $2.50 each

Primary Stop..... $6.00 doz.

(Discount for quantity orders)

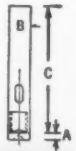
Automatic Stop

Cat. No.	A	B	C	D
9-11-6	3/16"	5"	5/8"	3"
9-21-6	1/4"	6"	3/4"	4"

Specify right or left hand

Primary Stop

Cat. No.	A	B	C
9-31-6	1/16"	3/8"	2 3/8"
9-41-6	3/32"	3/8"	2 3/8"
9-51-6	1/8"	3/8"	2 3/8"



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FAMOUS ERA BEAM COMPASS

Proven by 15 years' use by Leading Draftsmen and Designers for INKING and PENCIL DRAFTING

A fine precision tool. Hair-line adjustment quickly made and maintained by spring-loaded knurled thumb rollers. No screws or clamps. Lead expeller for easy control of lead length. Slides instantly interchangeable to any beam length. Made of anodized aluminum, stainless satin finish. Beam lengths from 7" to 100".

Combination Square

TRAMMEL HEADS

Make Accurate Compass, Height Gage, Outside and Inside Calipers.

Fits all Standard Combination Square Scales.

Heads chrome plated, screw parts protected by cadmium plating, scriber points made of hardened tool steel. Perfect for work on wood, plastic, sheet metal, linoleum, die or tool layout. Hundreds of uses. Comes complete with plated heads, scriber points, pencil tips, special caliper points.

$2.95 per Set; 6 Sets $17.00

ENGINEERING RESEARCH ASSOCIATES, INC.

3475 East Nine Mile Road Hazel Park, Michigan

CIRCLE INFORM-A-GRAM KEY NO. 1762

LEVIN® MICRO-DRILL PRESS

FOR VERY SMALL HOLES DOWN TO .002

Designed to hold small drills in precision collets, thus overcoming the difficulty of making a drill run true as when held in a conventional drill chuck. Absence of a sliding quill guarantees maximum sensitivity with fingertip control. A mounted 1/8" capacity chuck can also be used.

Send for Catalog L describing Micro-Drill Press, full range of collet sizes, accessories and other precision tools

LOUIS LEVIN & SON, INC., 782 E. PICO BLVD., LOS ANGELES 21, CALIF.

CIRCLE INFORM-A-GRAM KEY NO. 1763

PRECISION-FINISH YOUR OUTSIDE DIAMETERS

The Odee-HONE

- ★ ACCURATE
- ★ INEXPENSIVE
- ★ VERSATILE
- ★ LIGHTWEIGHT

Corrects out-of-roundness, waviness, chatter . . . Generates diametric size within .0001" tolerance . . . Hones all parts from 1/2" to 2 1/2" in diameter—regardless of length or material . . .

Can be used on any lathe, drill press, electric drill . . .

Simple to set up and operate—no aligning, fixturing or wheel dressing is necessary . . .

Removes a few "tenths" or a few "thousandths" stock in less time than it takes to re-center, indicate a part, and dress an abrasive wheel.

Write to:

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8100 SCHOOLCRAFT • DETROIT 38, MICHIGAN

Pendleton, Indiana • Evanston, Illinois • Los Angeles 23, California Brantford, Ontario, Canada

CIRCLE INFORM-A-GRAM KEY NO. 1764

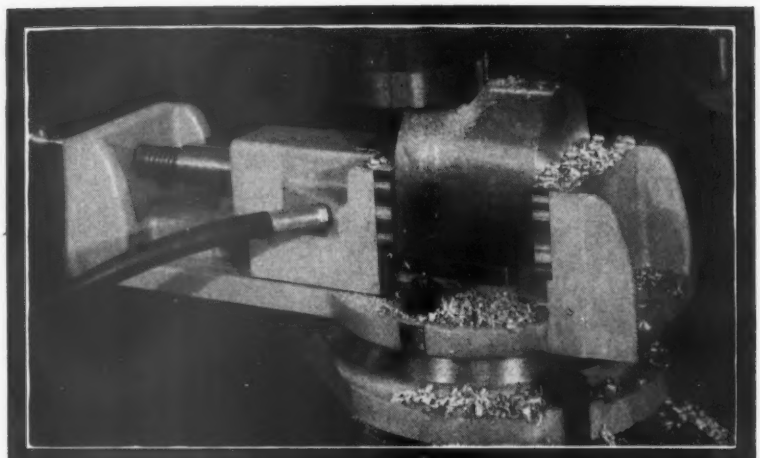
A New Automatic Mill Control Unit that provides automatic correction of thickness variations in materials being rolled has been announced by Pratt & Whitney, Divi-

sion Niles-Bement-Pond Co., West Hartford, Conn. The unit has been designated Model "E" automatic mill gage control unit and is for use in conjunction with continuous mill gages.
Circle Inform-A-Gram No. A49.

Torque Thumb Screws in four styles and 21 sizes are now available from the Siewek Tool Co., 2862 E. Grand Blvd., Detroit 2, Mich. These screws can be disassembled for cleaning the area retaining the ball and spring which govern the torque action of the unit. Also there is no washer before the head of the screw which makes it possible to use pliers or a wrench to adjust the screw to one's personal satisfaction. This makes for a true torque thumb screw.
Circle Inform-A-Gram No. A50.

Accessible Finger-Tip Speed Control in the top cap assembly of the Nu-Jett pencil-type grinder is a new feature recently incorporated in this handy hand tool manufactured by the Air Equipment Corp., 1355 Michigan

St., Grand Rapids, Mich. The control is now a flush integral part of the back cap assembly of the grinder. This places the control within easy reach of the thumb of the hand using the tool, or it may be conveniently operated by the forefinger of the other hand.
Circle Inform-A-Gram No. A51.



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The WiltOmatic "M M" Power Vise cuts loading time 80% and has a locking force of 9000 lbs. at normal air line pressure. This fast, strong, air powered hydraulic clamping means more production, less labor per piece on milling, drilling, grinding, shaping, broaching, and other machine applications. "MM" eliminates expensive tooling when specially shaped jaws are installed.

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925 WRIGHTWOOD AVE. • CHICAGO 14, ILLINOIS

WILTON TOOL CANADA LTD. GUELPH, ONTARIO, CANADA

CIRCLE INFORM-A-GRAM KEY NO. 1771

MORE FLEXIBILITY IN YOUR SHOP

Harden, heat treat, temper and anneal with one furnace . . the Johnson No. 706.

Another in the Johnson line of dependable gas equipment has won its place in both large and small shops and plants. Operators like its easy adaptability. Six Johnson Direct Jet Bunsen Burners with individual shut off valves and pilot lights provide steady, easily controlled heat from 300 to 1850° F. Semi-muffled type with burners operating below Carbofrax hearth. Firebox: 7"x 13"x 16½". Also available bench style. Write for complete and factual information.

A smaller version of this highly flexible furnace is the No. 654. Four burners deliver 300 to 1800° F. Firebox: 5" x 7¾" x 13½". Available as pedestal or bench style.

JOHNSON GAS APPLIANCE CO.

575 E Avenue, N. W., • Cedar Rapids, Iowa

Johnson No. 706 Pedestal Style	$300.00
Bench Style	$275.00
Johnson No. 654 Pedestal Style	$163.00
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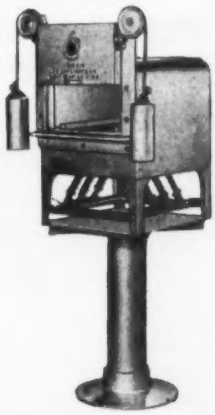
F.O.B. Factory



Model No. 706

JOHNSON INDUSTRIAL GAS EQUIPMENT

Furnaces • Burners • Torches • Valves • Mixers • Blowers

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Brinell Test

large pieces fast—with this long stroke machine

Large awkward castings, forgings or pipe are easily tested because the long stroke eliminates screw adjustment to work size. The hydraulic ram is controlled by a single lever. Large, stationary roller-type or flat table makes work handling simple, fits well into a conveyor line.

Choice of plain Brinell machine or the direct reading machine (shown, model DHL), where dial at end of ram gives comparative hardness immediately. Larger and special machines may also be had.

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Over 85% of the torque wrenches used in industry are

Sturtevant

TORQUE WRENCHES

Read by Sight, Sound or Feel.

- Permanently Accurate
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- Automatic Release
- All Capacities

in inch grams...inch ounces...inch pounds ...foot pounds (All sizes from 0-6000 ft. lbs.)

Every manufacturer, design and production man should have this valuable data. Sent upon request.

P.A. Sturtevant Co.

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Does jobs no drill can do!
up to 10 Times Faster than Boring!

NEW CC Clark

"HOLE-MAKER"

Totally new—maximum rigidity, no chatter! Roughs or finishes holes to exact size in FORGINGS, CASTINGS, BOILER PLATE, THIN STOCK, TUBING; CROWNED, CYLINDRICAL AND FLAT SURFACES. One of 3 blades is *always* in the cut on odd work shapes—*smooth action even on intermittent cuts!* Use new HOLE-MAKERS in radial drills, drill presses, turret lathes, portable electric or pneumatic drills, etc. Excellent for trepanning and rough boring I.D.'s in Tubing, Castings, etc...a real production tool!

Holes can't drift, spindle can't deflect—it's piloted 2 ways!

Cuts steels, plastics, transite, non ferrous metals, stainless steel, etc!

5 ADJUSTABLE SIZES: Specify Straight Shank or M.T. 2. 3. 4. Other tapers on order.

Models:	102	203	304	405	506
Capacity:	1" to 2"	2" to 3"	3" to 4"	4" to 5"	5" to 6"

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SPECIFY KASSON PRECISION COLLETS AND ATTACHMENTS

IMMEDIATE DELIVERY FROM STOCK

3AT, 3C 1A, 4C 5C

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All collets in hexagon, square and round.

KLUTCH-KOLLET

Step collet for accurate chucking to 2¾" dia. Soft head for easy boring. Lowest price on market! Models 3AT, 3C, 5C.

FOR ATLAS • LOGAN • SOUTH BEND CRAFTSMAN • SHELDON LATHES, ETC.

LEVER-TYPE DRAWBAR ½" cap.

Positive grip on undersize, oversize or standard diameter work! Patented coordinate cams eliminate fingers.

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RAPID SET-UPS with extreme accuracy—every time and on the first try!

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TOOL HOLDER

One Brookfield Tool Holder = One Conventional Tool Holder + Stock of at least 100 Bushings.

In Essence: A Floating, Precision Vise

- Adjustable V Jaw
- Axially True Design
- Balanced-Pressure Locking

No more fussing with bushings . . . just slip tool in jaw and tighten . . . run-out is less than .0001 per inch . . . Brookfield Tool Holders guarantee clean, easy, solid set-ups every time and on the first try! Models available for nearly all automatic and hand screw machines, turret lathes, radial drills, etc. Also useful as Adjustable Steady Rest and Work-Holder.

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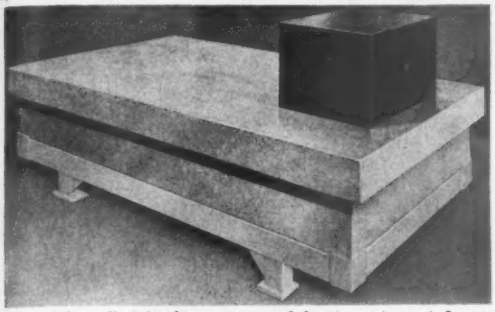
BROOKFIELD, INC. 240 Cushing St. Stoughton, Mass.

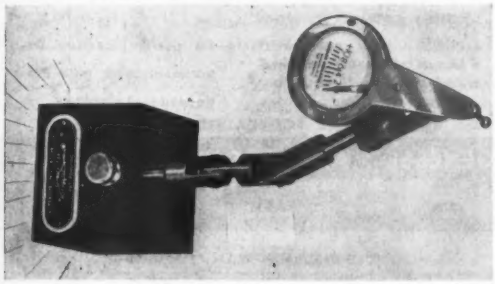
CIRCLE INFORM-A-GRAM KEY NO. 1785

Large Parallel Blocks made of black granite (diabase) are being produced by the Rahn Granite Surface Plate Co., 638 N. Western Ave., Davton 7, Ohio. These blocks



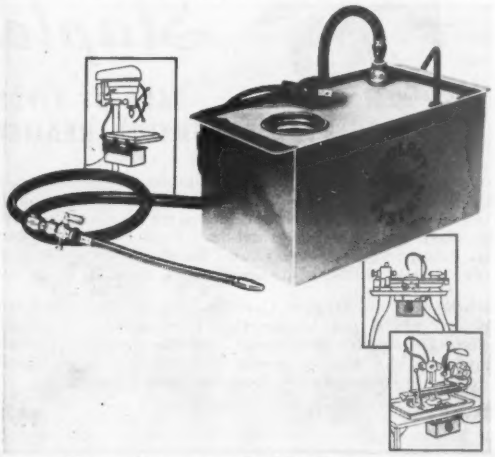
are precision finished on top and bottom to a tolerance of 0.0001" for flatness and parallelism. Illustrated is a block 24" x 36" x 20", and weighing 1900 lbs. It is used as a riser block for a rotary table, to hold the table the required distance above the 6' x 10' granite surface plate. **Circle Inform-A-Gram No. A52.**

A New & Unique Feature of this magnetic indicator base is the universal holder which is designed to fit practically any of the test or dial type indicators. This



combination tool, a powerful, permanent type Alnico magnet and detachable holder, is a product of the Superior Indicator Co., P. O. Box 734, Rochester 3, N. Y. **Circle Inform-A-Gram No. A53.**

This Portable Compact Coolant System can be easily attached to drill press tables and other small machine tools and benches, sizes 13" x 6" x 6". It is small in size, yet is powerful enough for any small machine tool operation. It has a flow adjustment from a trickle to full



stream. The unit saves valuable floor space and can quickly be moved from one machine to another. Complete specifications and description are contained in a bulletin on three model sizes that will be sent, upon request, by Viking Industries, Rockford, Ill. **Circle Inform-A-Gram No. A54.**

For QUICK PRODUCTION CHECKING of Parts in Large or Small Quantities

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Eliminates costly hand filing, sawing and lapping on dies, gauges, tools. So smooth-running that you can balance the flat end of a pencil on the table while machine is running.

Butterfly
Named "Butterfly" because they are as noiseless in running as a butterfly in its flight.

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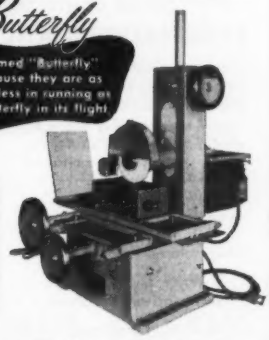
A dual-purpose machine. Rigid and powerful enough for deep roughing cuts, sensitive enough for fine grinding to highest accuracy. Dynamically-balanced spindle supported at both ends by duplex-mounted angular-contact ball bearings.



Write for description, specifications and prices

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Subsidiary of GERMANOW-SIMON MACHINE CO., Inc.
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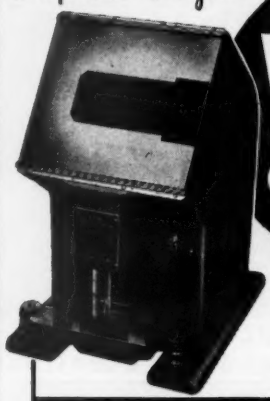
new WILDER small parts Comparator model C



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Designed for 100% Production Inspection
ACCURATE - FAST - INEXPENSIVE
Promotes Inspection Economy

If you manufacture mass produced parts that are now being inspected or should be inspected on an Optical Comparator, the new Small Parts Comparator will enable you to inspect them quickly, accurately and economically at a surprisingly low per-piece inspection cost.

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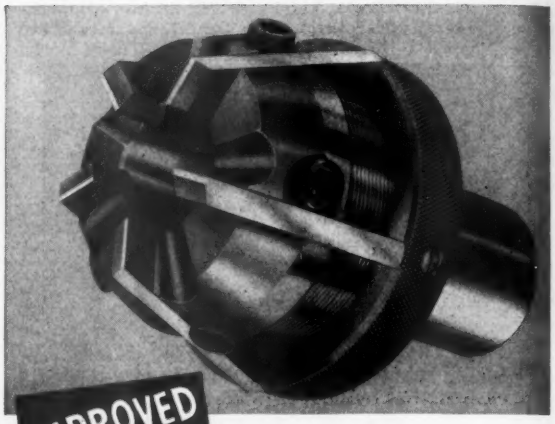

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There is a size and style Genesee for every hollow milling job. Standard sizes from 0 to 2", standard with straight or Morse Taper shanks carried in stock.

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- Let our Engineering Department solve your Production tool problems

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Adjustable Hollow Mills • Facing and Counterboring Tools • Special Production Tools

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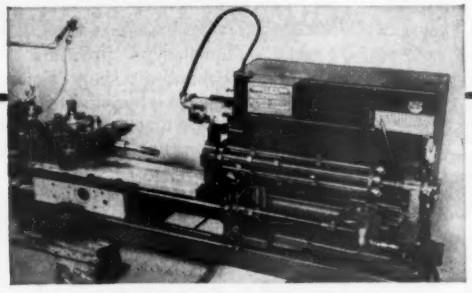


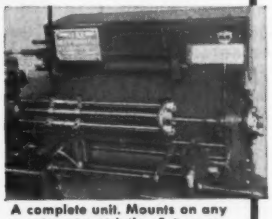
Deep Hole Drilling is Easier on a Turret Lathe Equipped with a LYNN RECIPROMATIC HYDRAULIC-DRIVE

Chips are cleared by drill automatically withdrawing at intervals. Re-enters in rapid traverse to depth of cut. Deep holes are drilled faster, more accurately, with less effort.

Apply reciprocating action to any, or all, turret stations—other stations are controlled by LYNN Recipromatic Hydraulic-Drive to make machining cycle completely automatic.

You produce more pieces to closer tolerances with less work.

Write TODAY for descriptive literature.



A complete unit. Mounts on any ram type turret lathe. Setups are simple, accurate. Efficient on long or short runs.

Other LYNN Products that increase production and lower costs include: Conversion Turrets—Self-Indexing Tool Posts—Slide Tools.

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CIRCLE INFORM-A-GRAM KEY NO. 1803

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Staples

CARBIDE-TIPPED SHELL TYPE EXPANSION REAMER*

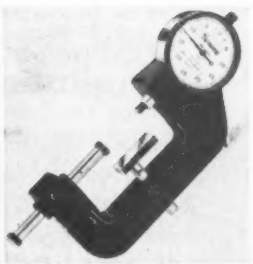
For maximum tool life with minimum tool servicing, put this Staples Shell Type Expansion Reamer on the job. Tool is returned to original diameter simply by driving the shell up the tapered arbor. Tool can be expanded many times without a regrind. To obtain a new tool, just order a new shell—a standard stock item.

Standardize on Staples Carbide-Tipped Circular Cutting Tools. You'll get longer tool life—greater accuracy—finer hole finish—and spend less time on tool servicing. Staples is the *quality* name in carbide tool production. You'll save money in the *long* run with Staples.

*Patented.

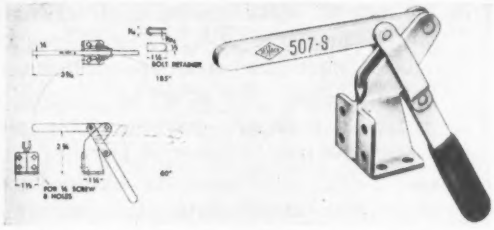
THE STAPLES TOOL COMPANY, Cincinnati 25, Ohio
Distributors in Major Cities
Staples CARBIDE-TIPPED CUTTING TOOLS
A complete line of Circular Carbide Tipped Cutting Tools
Expansion Reamers • Special Tools

CIRCLE INFORM-A-GRAM KEY NO. 1804



A Compact Precision Snap Gage with a fully adjustable but rigid large bearing surface backstop for fast, accurate comparison between workpiece and specification, a product of the Chicago Dial Indicator Co., Dept. A, 180 N. Wacker Dr., Chicago, Ill. Literature available. **Inform-A-Gram No. A55.**

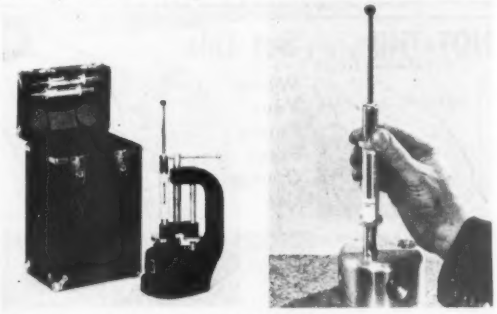
"Low Silhouette" & "Complete Clearance" are the two big features of the new Destaco Model 507 toggle clamps which has been brought out by the Detroit Stamping Co., 350 Midland Ave., Detroit 3, Mich. Specially designed to "hug the fixture" and with a "flop-over action" which flicks the spindle and holding bar completely away from the working surface, the low silhouette of these clamps brings new ease and convenience of work insertion and removal.



Circle Inform-A-Gram No. A56.

A Series of Adjustable Air Bore Gage Checks that have a measuring capacity from ½" to 8" with just four sizes, is now available from the Federal Products Corp., 1144 Eddy St., Providence 1, R. I. This series brings the sensitive accuracy and high magnification of the air measuring system to small production runs at reasonable costs. For further information write direct to the company, or— **Inform-A-Gram No. A57**

Metal, Plastic, Ceramic and Quartz Surfaces can be checked with a new portable hardness testing laboratory weighing less than 15 lbs. The unique testing kit designed by the Peabody Industrial Co., 2832 E. Grand Blvd., Detroit, Mich., includes two 7-oz instruments, one for testing steel in the hard range, incorporating both Rockwell C and Brinell 3000 Kg, equivalents. The nonferrous instrument has the Rockwell B and 500 Kg Brinell scales. A brochure containing complete details is available. **Circle Inform-A-Gram No. A58.**



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better, faster production at lower cost

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Correct spiral for fast cutting

High polish promotes chip flow

Improved rake angles for minimum loading

Job-engineered, master-machined

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The superior performance of FORD HSS Ground Cutters has been proven in on-the-job tests in countless applications, on ferrous or non-ferrous materials. If faster, better production at lower cost is your goal, get the facts on FORD.

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All specifications plus informative operational data on more than 300 FORD rotary tools contained in new FORD Catalogue No. 207. Write for yours!

FORD regrinding service adds tool life, reduces tool costs!

M. A. FORD MFG. CO., INC.

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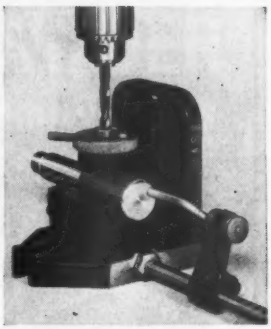
CIRCLE INFORM-A-GRAM KEY NO. 1811

NEW ADJUSTABLE DRILL JIG
eliminates layout; cuts drilling time



Used for drilling holes through round stock and hex stock from ¼" to 2" and cap screws from ¼" to 1¼", the new Mathewson Adjustable Drill Jig eliminates layout and can cut drilling time on small lots to a fraction. And it eliminates the costs of special jigs for larger quantities. Holes for cotter pins, set screws, drive pins for bayonet joints, oil holes in tubular sections, and wiring holes in cap screws, are all typical of the operation that can be done more economically with this jig. Hole diameters range from .052" to .531", using your A.S.A. standard slip bushings. The hardened V-block has two 60-degree V's for centering round or hexagonal stock, one for ¼" to 21/32" diameter, one for 21/32" to 2" diameter. Adjustable stop for locating work longitudinally for drilling any distance from end, may be used on either side. Adjustable bushing carriers hold slip bushings and clamp work securely. Jig highly successful in permitting use of inexperienced drill operators. For circular write to: **Mathewson Machine Works**, 38 Hancock St., Quincy, Mass.

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NOW *Non-Glare* SCALE and VERNIER with the FOSTER STAINLESS HEIGHT GAUGE

No more squinting, tilting to avoid reflection, magnifying-glass reading, causing undue eye-strain.

Vernier is 1.225 or twice that of ordinary gauges.

Write today for complete literature on the amazing FOSTER Height Gauge which will eliminate errors and increase reading-facility.

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- Extra Long Stainless Vernier, Chrome-Plated.
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Sizes: 12" to 48"

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CIRCLE INFORM-A-GRAM KEY NO. 1822

. . . Statistical Analyzer, from page 68

Application of the Analyzer

Some typical uses for which this equipment is intended are listed below:

1. **Process Control.** Continuous quality information on important characteristics can be made available to production, inspection and engineering personnel who can initiate correction before costly scrap is created.
2. **Learning more about our product.** Because of the high cost of gathering and analyzing quality data in the past we have largely neglected it. Now it is possible to learn much more about our manufacturing processes. The effect of changes in materials, processes, machines, time, personnel, can now be demonstrated dramatically. This will form the basis of cost reductions through better understanding.
3. **Automation.** Industry is moving toward the automatic production and inspection of parts in one continuous flow. The Statistical Analyzer is a logical link in this important development; it provides the quality history. . . while that history is being made.
4. **Quality Level Certification.** Certifying the quality of our products is becoming the accepted pattern of the day. Manufacturers record the quality history of the most important characteristics of their products and send this along with the shipment. The Analyzer now permits the automatic recording of this essential information in a universally useful form.

Applications of this equipment are too numerous to mention in detail. No doubt the reader will see possibilities in his own field where the Statistical Analyzer will perform a valuable service.

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PREVENTS INJURY—Saves Glove Costs. Feeds ferrous, non-ferrous strip or sheet . . . faster, safer! Use for stamping. Right or left hand non-slip fitted grip, self-adjusting. Sturdy hardened work surfaces. FULLY GUARANTEED

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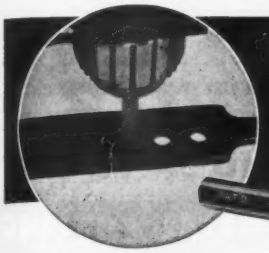

USE The New IMPROVED "HARDSTEEL" DRILL

With the new, improved "HARDSTEEL" Drill, you can do accurate, smooth drilling, countersinking, counterboring and reaming in steels hardened by any process without first annealing the work. And they work with equal ease on work-hardening steels and high carbon–high chrome steels of any degree of hardness.

"HARDSTEEL" Drills fit standard drill presses. They save time and reduce rejects. They permit engineering changes requiring additional drilling after hardening. And parts drilled after hardening always match at assembly.

Write for a copy of the "HARDSTEEL" Operators Manual showing how "HARDSTEEL" drills are cutting costs in thousands of plants.

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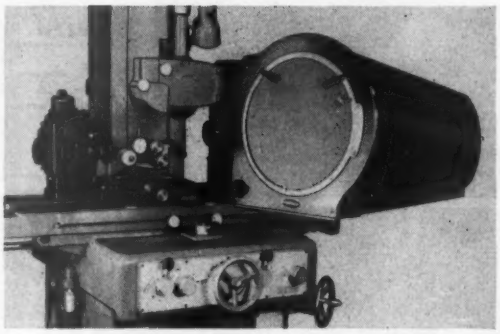
CIRCLE INFORM-A-GRAM KEY NO. 1831

the new PORTMAN

...Dual Purpose OPTICAL PROJECTOR



...is GRINDER MOUNTED

or for "Bench" Use

This new instrument is easily attached to a surface grinder for simultaneous finish-grinding *and* inspection . . . for *uninterrupted production* of flat and circular form tools.

Accuracy of configuration may be checked constantly and without loss of time. It can also be used on the "bench" as a regular Precision Optical Projector.

FEATURES: Dual purpose . . . grinder-mounted or for bench use; Higher production; Greater convenience; Lower costs (lower first investment and continual production savings!).

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BARNES ROCKET

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GRADIENT HARDNESS

1. HIGH SPEED STEEL
2. FLEXIBLE—TOUGH
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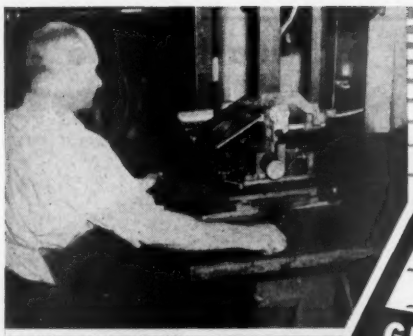

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WITH Tannewitz
HIGH SPEED BAND SAWS
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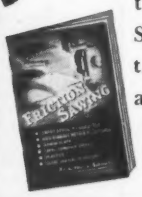

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. . . Precision Manufacture, from page 65

inspection. In Figure 12, the visual inspection standard for ball retainers shows precisely what the inspector must look for in four different areas of concern.

Frequency Distributions in Final Inspection

The histographic frequency distribution in Figure 13 represents a test for concentricity of standard ABEC Class #5 ball bearing on a gage similar to that in Figure 10. This frequency distribution serves as a final inspection record of the quality level of the lot. Review of such tests by the Quality Control Department aids determinations of the optimum sample size. In addition, the bearing user may request and receive copies of such frequency distributions for correlation with their receiving inspection reports.

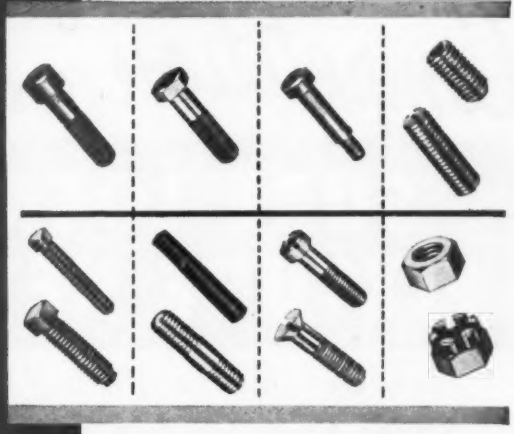
An extremely important activity in the quality control program is the continuing reporting of the quality level achieved to all persons in the plant. Three Weekly Graphic Analyses, for (1) assembled bearings, (2) inner rings and (3) outer rings, are posted permanently at various points in the plant to inform all personnel of the week's quality achievement. In addition, each Weekly Graphic Analysis, like that for assembled bearings in Figure 14, is officially turned in to management to present the overall quality control picture and the reasons for rejection or rework. In Figure 15, the curves for Percentage of Defective and Rejected Inners & Outers, covering a period of 18 months, are maintained continuously and also displayed in a prominent location along with a similar curve for assembled bearings.

Result of the Quality Control Program

In brief, the results of the quality control program at Miniature Precision Bearings, Inc. are:

1. **Reduced rejection rate** (including scrap and rework) — down from 38% of production to about 2% in 34 months.
2. **Inspection costs cut** — inspection personnel reduced from 30 to 12 while handling greater volume with greater reliability.
3. **Manufacturing costs cut 40%.**
4. **Improved employee relations** — pride in workmanship and in the higher overall quality level is very strong. The greater productivity of production personnel has resulted in a higher wage level.
5. **Improved customer relations** — better service and delivery and availability of formal quality records are major factors.

Cut Assembly and Production Costs with "CHICAGO" Standard Threaded Products



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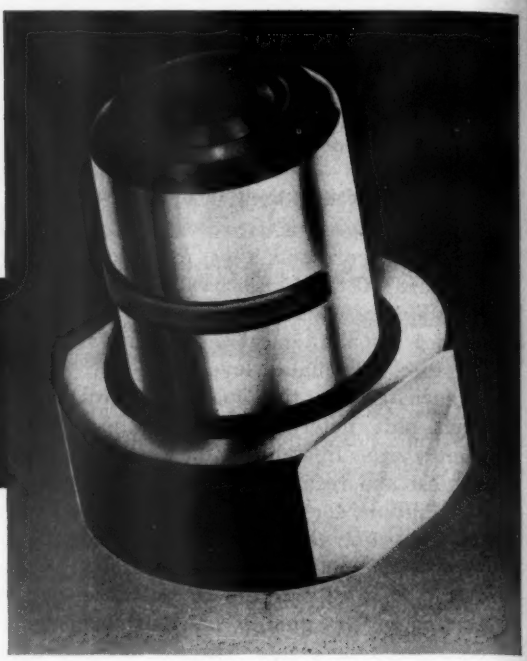

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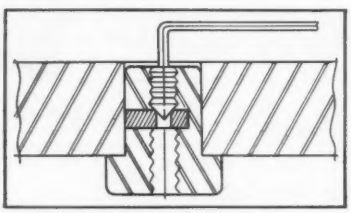

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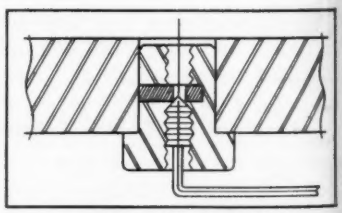

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A3	A20	A37	A54	B13	B30	B47	B64	B81	B98	C3	D2
A4	A21	A38	A55	B14	B31	B48	B65	B82	B99	C4	D3
A5	A22	A39	A56	B15	B32	B49	B66	B83	B100	C5	D4
A6	A23	A40	A57	B16	B33	B50	B67	B84	B101	C6	D5
A7	A24	A41	A58	B17	B34	B51	B68	B85	B102	C7	D6
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A16	A33	A50	B9	B26	B43	B60	B77	B94	B111	C16	
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A4	A21	A38	A55	B14	B31	B48	B65	B82	B99	C4	D3
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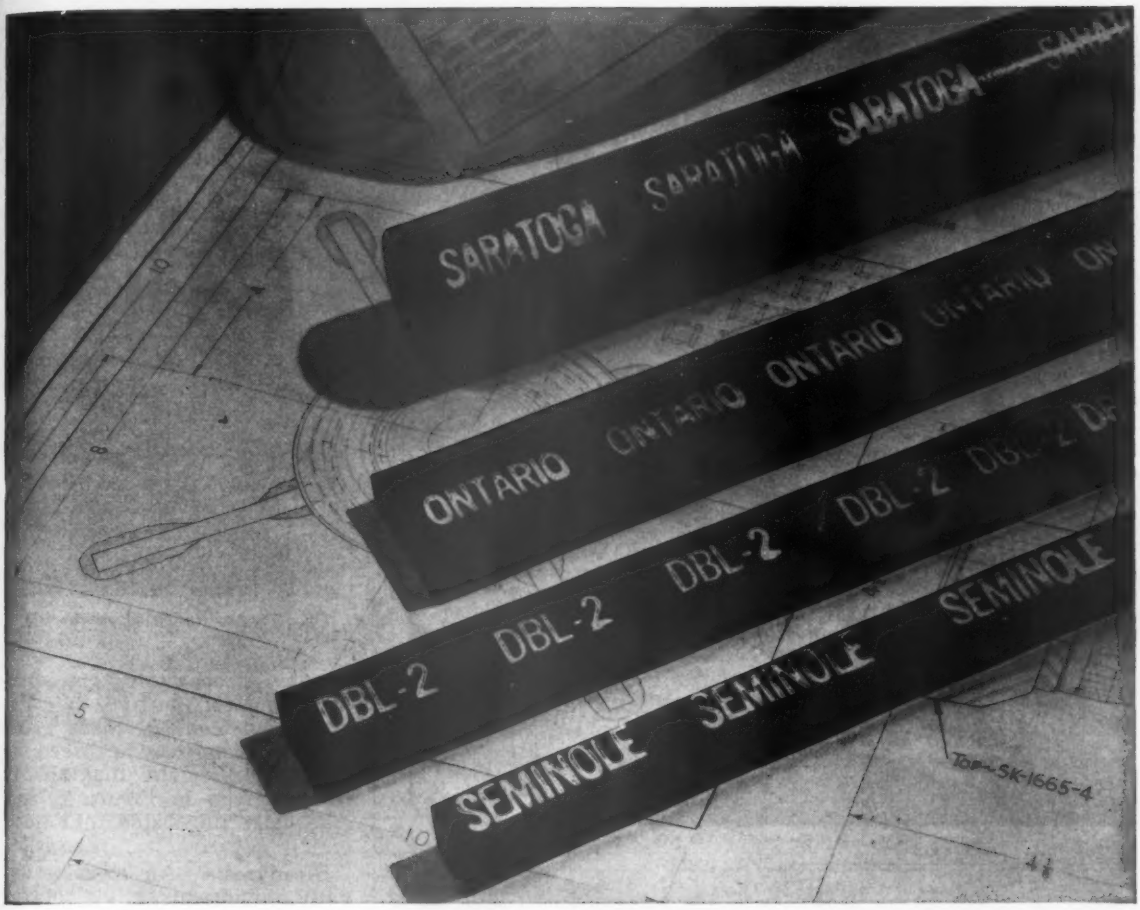

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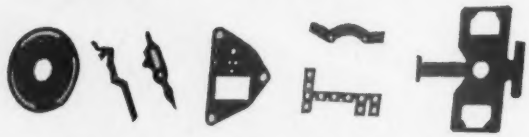

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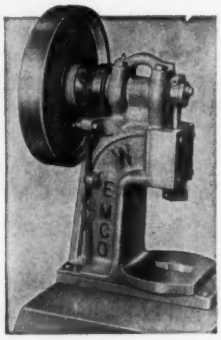

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CIRCLE INFORM-A-GRAM KEY NO. 1884

. . . Month's Talk, from page 112

problem was not too difficult to control, particularly if operator attention to a degree was available. We replaced a stationary half-nut for the feed screw by a rotary full nut. Rotation of this nut could be imparted by gearing and picker-pawl designs so that, for a given downfeed of the traversing diamond in the truing-device operation, an equal increment of advance of the wheel slide could be made without disturbing the wheel-feed index. A schematic diagram of this is given in Figure 7, and externally illustrated in Figure 8.

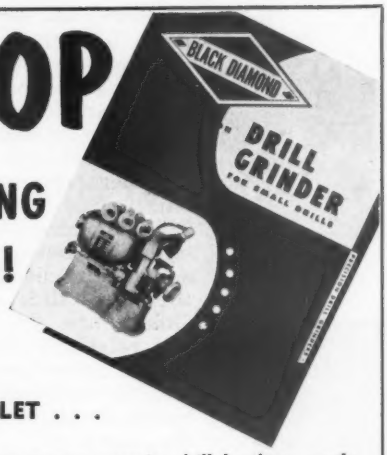
Fig. 8. Application of mechanism shown in Figure 7.

Steadyrests. An operator usually provides his skill in control of straightness and roundness through his manual operation of steadyrests. Designs have been made successfully incorporating automatic rotation of the shoe-adjusting screws. Some of these have been by clock spring-type device and others by hydraulic piston operating through rack-and-pinion train to rotate the adjusting screw. These devices include automatic retraction and cocking of the rotating device all associated in the cycle of the grinder operation, permitting the steadyrest to come into position of engagement with the work only after the grinding wheel has accomplished a degree of rounding up the work.

Wheel-Wear Problem. The effect in grinding brought about by the constantly changing wheel diameter as the wheel is used normally has offered no difficulties when an operator is present and can make changes to compensate. In the process of designing to transfer his skill into the machine, we must give thought to this wheel-wear prob-

. . . Continued on page 190

STOP WASTING DRILLS!



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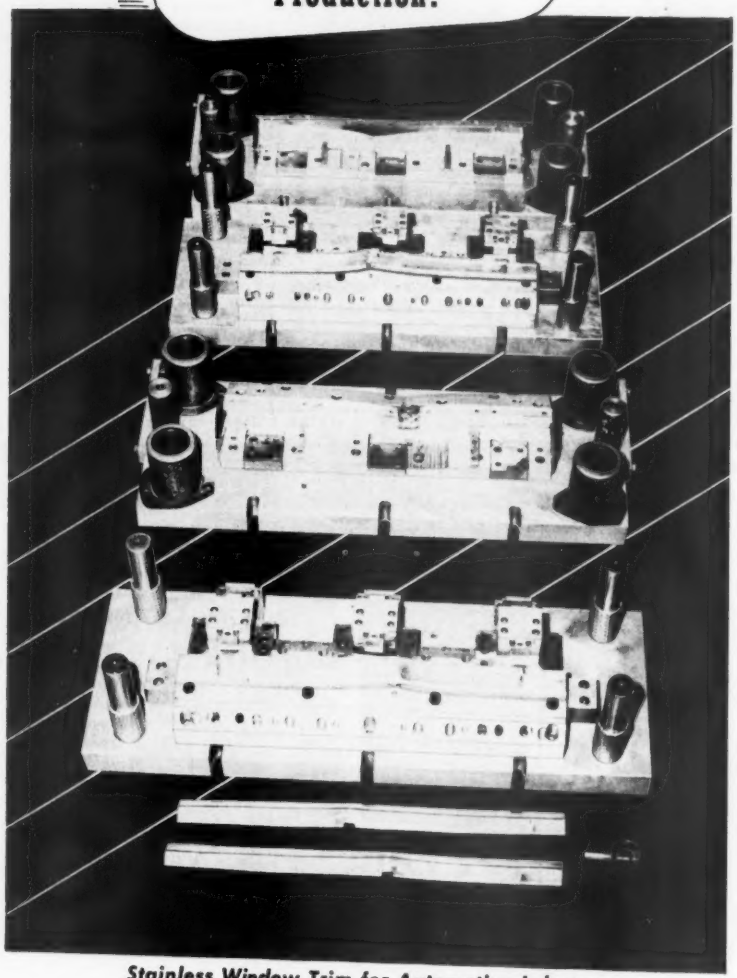

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. . . Month's Talk, from page 188

lem. Use of a variable-speed driving unit will permit introducing a possible spindle-speed change, and if controlled in a rate of change related to the wheel-diameter change, a constant peripheral speed of the grinding-wheel face will be available. Rheostat controlled d-c motors with cam control of the rheostat actuated by change in position of the wheel slide is one method. Others use electronic controls and relatively simple frictional contact drives having the driving member a constant peripheral-speed unit always in contact with the wheel.

Approaching The Automatic

As we approach a grinding-machine design, having transferred into its operation the skills of an operator, we recognize the importance of careful judgment of progressive accumulation of errors. Temperature changes, mechanical tolerances of gears and feed screws, way fits, lubrication variances, diamond wear, and so on, must not be disregarded.

It is when these various mechanisms are tied together by some form of automatic control that we are faced with the design attempting to equal the sense of the human in the ability to feel, see, and judge when to make the adjustments.

A recently designed fully automatic large grinding machine gave us all these basic problems to consider. A solution was developed around the fundamental desire that **the workpiece being produced automatically must be the controlling element if a satisfactory product was to be the result.**

It is recognized that design to solve only a specific requirement is not wise. Throughout the study of each component-mechanism design, it is imperative to build in selectable adjustments.

Provision in design for choice of adjustments makes it possible to adjust the ultimate performance of the machine to do the job assigned to it in a most practical productive and quality form.

Conclusion

We recognize the true importance of the marvelous machine which we call man, and that to replace him by mechanism de-

. . . Continued on page 192

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Dear Reader,

Our advertisers tell us that their advertisements in *TOOLING and PRODUCTION* are extraordinarily effective.

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Cordially,

Geo. J. Hubner

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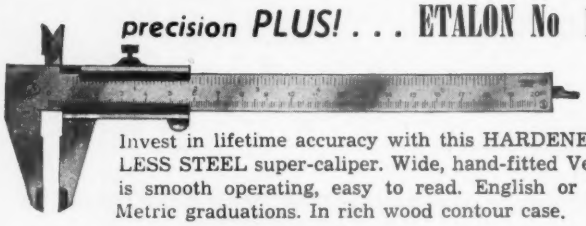

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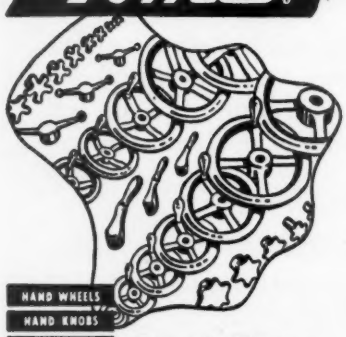

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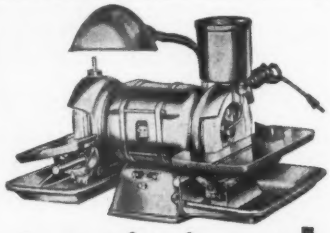

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GRINDERS

CIRCLE INFORM-A-GRAM KEY NO. 1924

. . . Month's Talk, from page 190

sign within a machine a considerable investment in design and mechanism will be required. Accordingly it may be deduced that **there must be some point where there is an economical advantage to stop the design efforts directed towards the completely automatic machine.** However, each job has its own conditions and there are cases where it is economical to expend the efforts and funds which result in a machine which has built into it as much of man as is possible. A machine which is automatic requires careful attention to design details which not only keeps it productive, but also keeps it producing acceptable first-quality work with a minimum of downtime for control of expensive maintenance.

Progressive transfer of skills from operator to machine has been in progress over the past years and today we are experiencing the possibilities which modern industry expects, particularly as the automatic machine or "Automation" is demanded.

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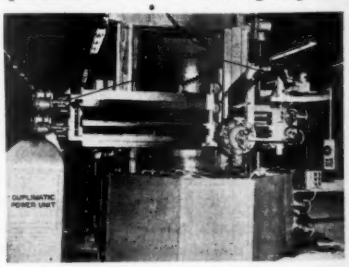

tor. This unit attaches to practically any machine tool and controls machine movements automatically.

Tracer Control Co., 595 E. 10 Mile Rd., Hazel Park, Mich., has purchased complete rights to this duplicating device from Lodge and Shipley Co., for whom they were previously national distributors.

Tracer Control, also, has incorporated several improvements in the design of the duplicator, making it completely flexible. Setup and dismounting is now a matter of minutes, and when connected, the duplicator does not interfere with conventional use of the machine. **Circle No. D2.**

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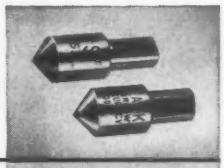
CLARK Diamond Cone Penetrators are exactly right for your "Rockwell" hardness tester, whether or not it bears the CLARK name. Every step in their manufacture, from careful diamond selection to expert lapping, leads to a precision product that will give you precision results. Yet CLARK Diamond Penetrators cost surprisingly little.



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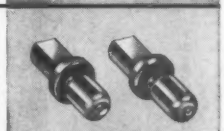

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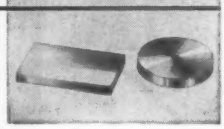

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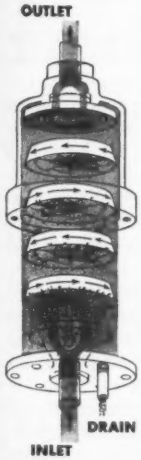

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The Aridifier protects tools against the freezing, fouling, caking and corrosion caused by dirt and foreign matter . . . assures the clean, dry air and gas that means better spray work, painting, lacquering, sand blasting, air cleaning, and similar operations.

Easily installed, the Aridifier maintains itself. 10 models. Capacity range; 7 CFM to 17,000 CFM.

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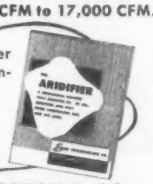

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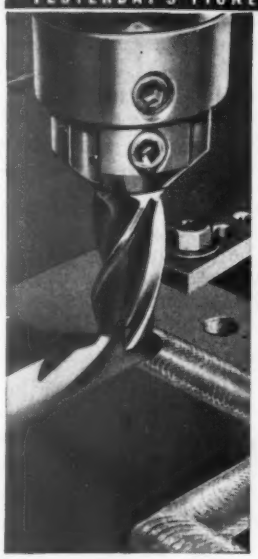

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• Look at this rugged 2″ diameter Weldon end mill with 4″ long flutes which made a 2½″ deep cut in a solid block of die steel—4140 steel heat treated to 260 Brinnell. The feed was 1½″ per minute, and the material was removed at a rate of 7½ cubic inches per minute.

This HEAVY DUTY Weldon end mill is held by a new-style end mill holder which bolts securely on to the nose of the milling machine spindle. The holder, located by a centering plug, is driven by two drive keys on the spindle nose. The 2″ diameter shanks of these heavy-duty end mills are securely held by two large hollow head screws.

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CIRCLE INFORM-A-GRAM KEY NO. 1933

Solving High Pressure Pneumatic Testing Problems

by Clayton H. Propper
Chief Engineer
THE HERMAN MACHINE & TOOL COMPANY
Tallmadge, Ohio

HIGH PRESSURE pneumatic testing has always presented problems to manufacturers. This type of testing equipment nearly always involves high cost, consumes large areas of factory space, and in many cases is not as efficient and safe as desirable or required.

The Herman Machine & Tool Company, Tallmadge, Ohio, was faced with these problems when they received an order for small diameter pneumatic cylinders. The high cost and extended delivery of the present type high pressure testing equipment made management realize that something had to be developed in their own plant if required delivery schedules were to be met. Accordingly, their engineering department designed and built special testing equipment which combines simplicity and effectiveness with low cost of operation and minimum of maintenance.

The Herman testing equipment consists of a suitable steel stand having a Plexiglas covered inclosure in which the cylinders are placed for pressure and leakage tests. Each cylinder is individually connected with a supply of nitrogen gas through valves and gauges in a manner that permits the removal, or replacement, of any one cylinder at any time. It is of great advantage that each cylinder is connected separately and may be removed, or installed, at any time during the test without disturbing the test procedure of the rest of the cylinders mounted on the same test stand.

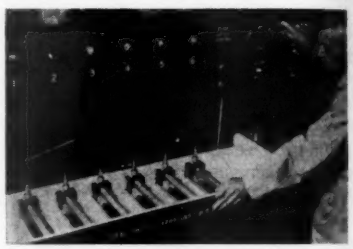

Fig. 1. Partial front view of the Herman pneumatic cylinder testing equipment showing cylinders in place for the 3200 psi five minute test.

The high pressure phase of the problem was solved in a simple, safe and efficient manner by inter-connecting nitrogen gas with a closed hydraulic system. A control system, actuated by solenoid valves and mercury switches, returns the oil to storage and delivery tanks for use in the next compression cycle. This method eliminates refilling and waste, and simplifies the operation and maintenance of the system, thus making it possible for all testing operations to be conducted by one person.

The cylinders are placed in the test stand, pre-set and locked into place by a comparatively low pressure. The operator makes sure that all cylinders are prop-

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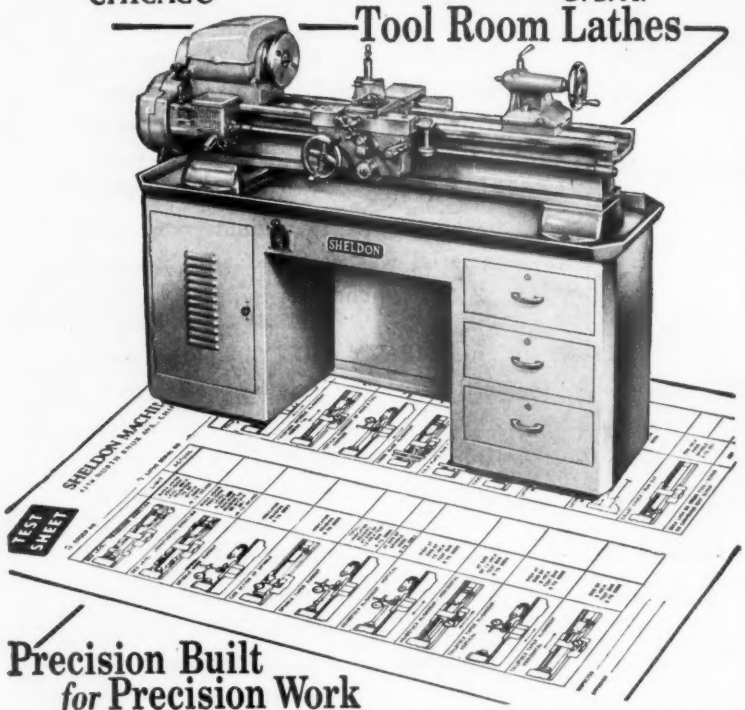
CHICAGO U. S. A.
Tool Room Lathes



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4235 North Knox Ave., Chicago 41, Illinois

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erly seated, then applies the high pressure. The high pressure leakage test is performed by subjecting the cylinders, after they are mounted in the test stand, to a pressure of 3200 psi for five min-

Fig. 2. Side view of equipment for testing pneumatic cylinders under high pressure. Note valves and gauges, cylindrical steel shell in which bursting test is made at right of testing stand, and nitrogen gas container.

utes. If leakage is present in this test, the cylinder is immediately removed from the test stand, and the cause of leakage determined and corrected. After the cylinders have passed the short duration high pressure test,

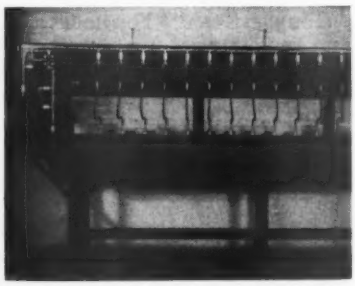


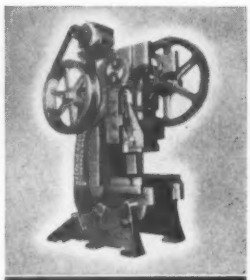
Fig. 3. Partial rear view of high pressure testing equipment, designed to test small diameter pneumatic cylinders. Note piping, which connects to cylinders pre-set in testing stand.

they are placed in a similar rack and subjected to a pressure of 1600 psi for a period of four hours. The pressure must not, under requirements of the contract, exceed 25 psi drop during the four-hour test period.

A random burst test is required where the cylinder is placed in a cylindrical steel shell with a Plexiglas cover, and is subjected to a hydraulic pressure of 10,000 psi (bursting pressure requirement is 6400 psi).

It is obvious that the testing equipment required tc meet such rigid specifications must operate with the utmost efficiency, be safe, dependable, economical, and as compact as possible. The Herman testing equipment was designed with the thought in mind that the units being processed would be tested to the required specifications, and that the equipment would not only meet, but in many instances, exceed the strictest requirements of efficiency, safety and economy.

Each pneumatic cylinder manufactured by The Herman Machine & Tool Company is thoroughly and carefully tested before it leaves the factory, and with this new testing equipment, Herman is in a position to build and test a large selection of pneumatic or hydraulic cylinders covering wide pressure ranges. It is quite obvious that the cylinders produced and tested must meet the highest material, quality, durability and efficiency standards.



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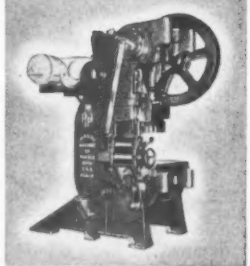

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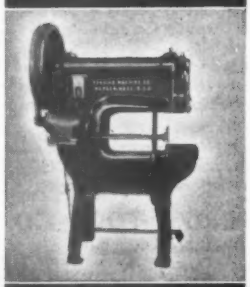

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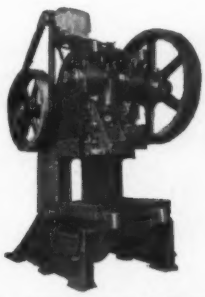

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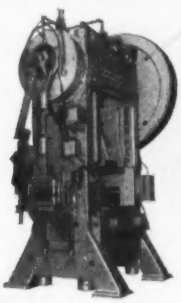

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CIRCLE INFORM-A-GRAM KEY NO. 1951

How To Select The Proper Tooling Source

Select the company that designs and builds with its own equipment on its own premises.

Insist that the company give a financial guarantee as to the dimensional and functional accuracy of each design.

Insist that the company produce finished parts on each tool and have them pass your inspection prior to acceptance of the tool.

by John A. Frink
President
MECHANEERS INCORPORATED
Bridgeport, Conn.

Insist that the company financially guarantee its delivery date.

Insist that the company give a firm bid on the cost of each and every change.

Investigate the premises and personnel of the company preferably by visiting them without advance notice.

Judge your source by how much repeat business it has done for the same clients.

Do everything on a normal, businesslike, guaranteed-result basis; above all do not sign up any blank-check, open hourly arrangements.

The function of a good tooling service firm is to help carry your peak loads and to provide a service at a price and quality that is better than you can do in your own plant.

There are several good firms in this country who year after year continuously perform on this basis.

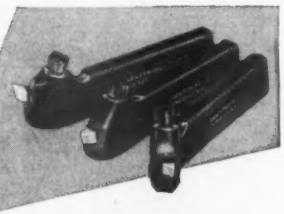
If you are among the many firms who have tried outside tooling services and have been disappointed with the results, we suggest that: You look back and review your experience and honestly decide whether or not many of the causes of dissatisfaction were not your own fault.

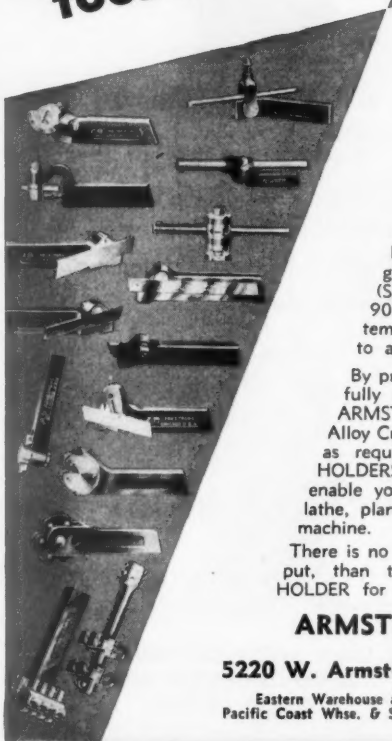
In most cases, if you had followed sound business principles the way you do in all other phases of your business, you would have weeded out, right in the beginning, and worked down to some of the better tooling service firms in the country. You would have found, as many other companies have, the services of a good tooling firm are an invaluable aid to the proper and efficient operation of a modern business.

Most good tooling service firms are listed as affiliate members or active members in the larger tooling organizations of this country. They will bid your jobs at sensible prices where they make a normal profit. They will give you service, they will give you quality, they will give you top results on a guaranteed performance basis.

T. R. "Tom" Gill has been elected President and a member of the board of the General Supply Company and the G. S. Equipment Company. Both firms are located in Cleveland. Mr. Gill is also Vice President of the Singleton Company, another Cleveland organization. He is General Manager and a Director for all three corporations.

ARMSTRONG
TOOL HOLDERS





answer both . .
1. The problem of lowering costs
2. The problem of increasing output

By providing permanent, multi-purpose, inexpensive ARMSTRONG TOOL HOLDERS that use cutters or bits that are quickly ground from standard high speed shapes (Saving: All Forging, 70% Grinding and 90% High Speed Steel), the Armstrong System of Tool Holders will reduce your tool cost to an absolute minimum.

By providing stronger, more efficient tools, carefully developed for each operation, as well as ARMSTRONG High Speed Steel, ARMALOY Cast Alloy Cutter Bits or Armide Carbide-Tipped Cutters as required for each job, ARMSTRONG TOOL HOLDERS permit greatly increased speeds and feeds, enable you to increase the hourly output of every lathe, planer, slotter, shaper, turret lathe and screw machine.

There is no surer way to lower costs and increase output, than to use the correct ARMSTRONG TOOL HOLDER for each operation on all machines.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
5220 W. Armstrong Ave. Chicago 30, U.S.A.

Eastern Warehouse and Sales: 199 Lafayette St., N. Y. 12, N. Y.
Pacific Coast Whse. & Sales Office: 67 Eleventh St., San Francisco 3, Calif.

CIRCLE INFORM-A-GRAM KEY NO. 1961

The **Frank L. Colker** Company in Detroit has been appointed Michigan Sales Representative for the Elwell-Parker Electric Company of Cleveland.

◆

Donald R. Hoover is the new Sales Representative assigned to the greater metropolitan Chicago area for the Vulcan Stamping & Mfg. Co. and the Vulcan Tin Can Co., both of Bellwood, Ill.

◆

Clifford R. Boeckler has been appointed District Manager of the new Western New York Territory office of Niagara Machine & Tool Works in Buffalo.

◆

With four years experience in Miller Fluid Power Company's Order Processing and Sales Engineering Departments, **James E. McComb** has been appointed Miller's new Field Engineer for the San Francisco area.

◆

Theodore F. Eichstaedt has been appointed Assistant Manager of the Machinery and Tool Division of Joseph T. Ryerson & Son, Inc. He was formerly Manager of the Machinery and Tool Department at the firm's Chicago plant.

◆

Latrobe Steel Company, Latrobe, Pa., has announced the appointment of **R. C. Kohl** as special Sales Representative in the Buffalo office. **R. A. Gleason,** former Sales Representative becomes District Sales Manager of the Buffalo office. **T. A. Curtis,** Sales Representative attached to the Newark, N. J. office will move to Rochester, N. Y. to become Resident Salesman there. **R. J. Tobey,** St. Louis, Mo., salesman will become resident salesman at Fort Wayne, Ind. In Atlanta, Ga., **Joseph Breiner** will be in charge of Latrobe's newly opened office, representing the firm in Georgia, Alabama, Florida, and eastern Tennessee.

Paul W. Moehle has been appointed West Central Region Manager for the Detrex Corporation of Detroit.

◆

Added to the Sales Department of Ace Drill Bushing Co., of Los Angeles were **R. J. (Jack) Herbert,** located in Chicago, who will handle the Chicago-Detroit-Cleveland areas, and **William Burke,** located in New York City who will cover the New York, Philadelphia, Boston areas.

Appointment of **H. J. "Jack" Crain** as Sales Engineer for the Modern Industrial Engineering Company has been announced by the Detroit builder of production deburring and special machinery.

◆

J. H. Williams & Co., Buffalo, N. Y., manufacturer of industrial wrenches, tools, and drop-forgings, announces the appointment of **Dale Bethke** as Sales Representative for the state of Michigan.

Buck

AJUST-TRU

PAT. NO. 2,639,157

CHUCKS

Only universal scroll chuck with .0005" precision—for lathes, grinders, dividing heads, screw machines.

3-jaw and 6-jaw in 4", 5", 6", 7½", 9" sizes. 2-jaw Aviation chucks, for odd-shaped parts, in 6", 7½", 9" sizes.

ALSO SUPER-GRIP 4-JAW INDEPENDENT CHUCKS FOR 9" to 16" LATHES.

LOW COST PRODUCTION
on Lathes-Grinders

Buck Ajust-Tru 7½" chuck turns bar stock and shafts to consistent precision at The Set Screw & Mfg. Co., Bartlett, Illinois.

Shop superintendents everywhere report their satisfaction with the way these universal scroll chucks cut machinists' time, line up *dead true* in *one* minute, hold to within .0005" re-chucking precision on duplicate parts. Some report cost savings of up to 50% per operation. The Buck chuck ends most needs for stub arbors, mandrels, special fixtures . . . adapts to lathes, screw machines, grinders, dividing heads.

Make your next chuck a Buck. It will save money every time you use it. Send for latest catalog.

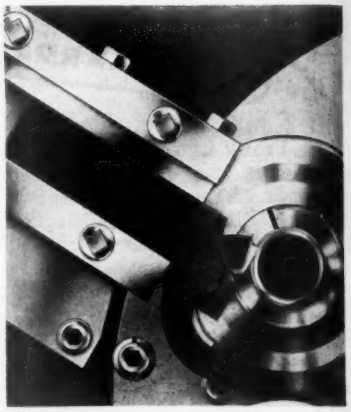
BUCK TOOL COMPANY
918 SCHIPPERS LANE • KALAMAZOO, MICH.

CIRCLE INFORM-A-GRAM KEY NO. 1971

CIRCULAR BLADE CUT-OFF TOOL LINE EXTENDED

The many advantages of the Cir-Cut circular-blade cut-off tools will be available to users of most multiple-spindle screw machines, according to officials of the Carbide Tool Co. of Detroit. This firm recently took over manufacturing and distribution rights to the Cir-Cut Tools developed and primarily marketed by The New Britain Machine Co.

The numerous time and stock saving features of the tool hinge on the circular-blade construction. The blade is removed for grinding without removing the holder, eliminating operator error in resetting and reducing machine down time; and, it is possible to use thinner blades because of the rigidity of the circular shroud-blade assembly, thereby saving stock. Because the adjustable shroud can be ground at any angle for chip curling, there is a minimum of tool overhang and chips can be directed without hooking the blade.



Lines etched on the blade face make regrinding a simple matter: just grind the dull blade parallel to the next etched line, within normal visual accuracy. This grinding can be done in fixture by tool room grinders. To replace the blade, line up the sharpened blade with the front edge of the holder and tighten the blade-holding screw. The tool will then automatically hold center and size because the holder has not been disturbed during the regrinding process. Proper relief and rake angles are automatically provided, as is side-clearance taper.

The Cir-Cut line will be available in various blade widths and in either carbide or high-speed-steel. Tools are presently available for New Britain, Warner & Swasey, Cone, and Acme-Grindley machines, 1⅜" minimum bar capacity. Other sizes and adaptors for all popular makes of multi-spindles will be available later. For further information write to Carbide Tool Co., 1304 Harper Ave., Detroit 11, or—**D3.**

More than 1,000 engineers and technicians will be added to Convair's engineering department in San Diego within the next year. Hiring of the engineers has started with Convair personnel interviews already visiting major cities and colleges in the United States to explain employment opportunities to applicants. Four-hundred of the additional personnel will be electronics engineers and technicians for assignment to long range projects under development for the Armed Forces.

Now you can buy
a press brake like this "off the shelf" for $1455

Verson now offers standard brakes with immediate delivery from stock

Any shop where metal is bent can now take advantage of a new convenient way of buying quality all steel press brakes. There's no need for involved proposals or a long wait for delivery. You can now buy Verson No. 16-48 and No. 1062 brakes as easily as buying a car. Prices are published publicly and delivery of standard models is made from *stock.*

The 16-48 (shown above) has 15 tons capacity and will bend up to 48" of 16 ga. mild steel. It is priced at $1455. The 1062 has 25 tons capacity and will bend up to 78" of 16 ga. mild steel. It is priced at $2190. Standard 90° "V" dies are also available from stock. 78" long set for the 1062 is priced at $124. 48" long set for use in either machine is priced at $93. These dies are capable of handling 16 ga. steel.

Write for spec sheets on either model and then place your order. We think you'll like this new way of buying equipment.

A Verson Press for every job from 60 tons up.

ORIGINATORS AND PIONEERS OF ALLSTEEL STAMPING PRESS CONSTRUCTION
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MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES • TRANSMAT PRESSES
TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES

CIRCLE INFORM-A-GRAM KEY NO. 1981

GROWING PAINS

Now being constructed is a new general office and factory building in Schiller Park, Ill., for **Wilton Tool Mfg. Co., Inc.** Hugh W. Vogl, Wilton's President, reports this expansion program will cost approximately a half million dollars; and roughly 65,000 sq. ft. of floor space will be included in the single-story main building.

◆

A new $1,250,000 addition for the manufacture of shell molded castings is nearing completion at the **Lynchburg Foundry Company,** Lynchburg, Va. Limited production already is in process and the plant will be in full operation by the end of October.

◆

Northern Engineering Works has recently completed a building expansion program at its plant in Detroit, which included a new 20,000 sq. ft. assembly building, an addition to its existing structural fabricating area and complete new heating facilities.

◆

Salkover Metal Processing of Illinois, Inc., founded in Chicago in 1941, has moved to new quarters in Franklin Park, Ill.

◆

A $300,000 plant addition to the **Enamelstrip Corporation's** plant in Allentown, Pa., is expected to be completed by the end of 1954. The new building will house administrative offices and also will be used for warehousing, fabricating, and shipping.

◆

Completion of its move to new and larger quarters has been announced by the **R & S Tool Co.,** Cleveland manufacturer of tungsten carbide and high speed cutting tools. The new 8,500 sq. ft. building is located on Cleveland's west side.

The Dow Chemical Company has formally opened its magnesium mill in Madison, Ill., for the production of magnesium alloy ingot, magnesium extrusions, and magnesium sheet and plate.

◆

Dedication of the new **Buckeye Tool Corporation** plant in Dayton, Ohio, was recently made. The new single-story structure occupies 25,000 sq. ft. of floor space.

Increased production of the Corporal, the Army's most advanced weapon in the guided missile field, was assured by Harvey S. Firestone, Jr., Chairman of the **Firestone Tire & Rubber Company** of Akron, following inspection, recently, of the firm's new factory under construction in Los Angeles. The new $2,000,000 plant is located adjacent to the rubber company's main west coast tire plant. It contains 350,000 sq. ft. of floor space and will augment present missile manufacturing facilities.

CIRCLE INFORM-A-GRAM KEY NO. 1991

. . . Magnetic Comparator, from page 85

a. An impairment of magnetic properties occurs within the range 100-200° F.

b. Magnetic properties increase, as would be expected, within the range of 200-1000° F as stress relief annealing occurs.

c. Magnetic properties continue to increase as recrystallization occurs and as the completion of this recrystallization is followed by a small amount of grain growth.

d. Surprisingly, there is no abrupt change in magnetic properties corresponding to the abrupt change in hardness as we move from the stress relief annealing to the recrystallizing and process annealing ranges.

e. Attainment of the lower critical temperature is indicated by a decrease in magnetic properties and an increase in hardness.

f. A study of Figure 3 indicates the possibility of research on time-temperature relationships with results based on magnetic readings.

Heat Treating

The application of heat treating to the steel cartridge case brought on a serious new problem. Cartridge case steel (SAE 1030) has poor hardenability characteristics. Alloyed steels cannot be used because of short supply in wartime. Unless the heat treatment of the carbon steel is carried out very carefully, sufficient hardening cannot be effected. A case poorly heat treated can be far inferior to a case not heat treated at all, since the latter at least possesses cold-worked hardness. With the many variables existing in the heating and quenching operations, we must have some way to check each case rapidly and non-destructively. A visual check cannot be relied upon to distinguish between a poor and a satisfactory heat treatment. Hardness testing is time-consuming, subject to operator inaccuracies, and not sufficiently exact within the narrow hardness range to which we are confined. One type of testing — magnetic comparator testing — has proved to be the answer.

Fig. 4. Magnetic comparator setup with automatic positioning device.

Magnetic control over the heat treating operation owes its success to the fact that the heat treatment of a steel is one of the most important determinants of the steel's magnetic characteristics. The better the heat treatment, the less magnetic the steel. The actual effectiveness of the heat treat operation, i. e., the degree of transformation of the steel to a martensitic structure, can therefore be determined.

Our cases are heat treated by induction heating. Each case is inserted into an induction coil until the lower sidewall is brought up to a temperature of approximately 1800° F, at which point a water quench is applied. A magnetic check immediately follows this heat treating operation. Here the magnetic standards of acceptance and rejection have been carefully set. All cases which fall within the permissible magnetic range have been heat treated satisfactorily; those falling outside this range are held aside as rejected. To simplify the testing, we have made the operation more or less automatic. Each case to be tested is dropped down a chute, as illustrated in Figure 4. Note the heat-treated base of the case, which is to be tested, and the annealed mouth, which has been softened for subsequent tapering. The case is automatically positioned so that a predetermined area within the heat-treated zone falls within the "variable" coil. A reading registering o u t s i d e the permissible range causes a bell to ring, warning the operator to reject the case. Rejected cases are reported promptly so that the cause of rejection can be immediately determined.

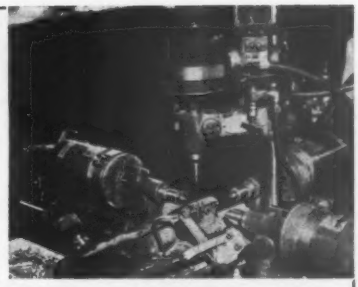
At various times we have had cartridge cases rejected by the comparator for unsatisfactory heat treatment traceable to the following: low quench pressure; overheated quench water; clogged up quench holes; excessive variation in electrical input; faulty rotation of cartridge cases in induction coils; breakdown of timing mechanism.

Existence of Decarburization

When a case is rejected by the comparator, it may not actually be the result of a poor heat treatment. A decarburized surface may occasionally exist. Since iron is much more magnetic than steel, and a lower carbon steel more magnetic than a high carbon, the decarburized area will cause the magnetic properties to increase. Because the flux penetration is only

. . . Continued on page 203

SMALL HOLE DRILLING SPEEDED AUTOMATICALLY



Pictured above is an E-M drill head setup that has been used for years in a large gasoline engine manufacturing plant. Operation starts automatically when the piece is clamped in place. Three cross holes are then drilled followed by a fourth axial drill to size and deburr. Hole sizes range from No. 60 to 50. One man completes all operations at once whereas four separate operations were required before E-M automatic drill heads were used. Production and quality are way up, and stay up year after year.

Perhaps you have a similar operation in your plant that is adaptable to faster, more efficient E-M automatic drilling. There is no obligation for our engineering service.

The outstanding features of the E-M automatic drill heads listed below, can cut your small hole drilling costs to a minimum:

1. 1000 to 10,000 or 2,500 to 15,000 RPM ball bearing motor with instant speed selection insures maximum drill efficiency.
2. Super accurate checking capacity .004" to 5/32" with selected chuck or collets, and vibration-free direct spindle drive provide a true running drill for precision and longer life.
3. Positive air feed to spindle with rapid approach to work and completely adjustable hydraulic feed control through the full depth of the work and during breakthrough.
4. Guaranteed precision and accuracy results from a decade of service to the field.

PRICE COMPLETELY EQUIPPED $253.00 and up

the ELECTRO-MECHANO Co.

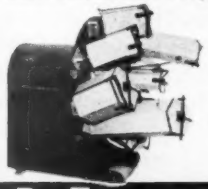
260 E. ERIE STREET • MILWAUKEE 2, WISCONSIN

CIRCLE INFORM-A-GRAM KEY NO. 2011

TUMBLE FINISHING COSTS

One BMT Multi-Barrel SlideHoning unit with 48" revolving disc and wide range of stationary mounted barrels does work of eleven or more conventional tumbling machines. Offers exceptional space and cost savings.

Angle mounting of barrels provides exclusive SlideHoning—a controlled combination of rotary, centrifugal, and end-to-end slide actions—that finishes metal or plastic parts normally considered impractical for conventional tumbling or done expensively by hand.



FOR TEST RUN: Send sample (up to 25 lbs.) and finished piece, prepaid. Process sheets furnished for cost comparison. No obligation on your part.

Write for FREE brochure "Modern Precision Tumbling."

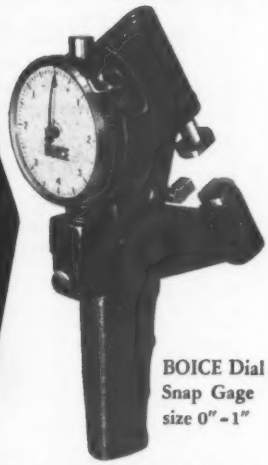
*Trademark Pat. U.S. Pat. Off.

BMT Manufacturing Corporation, 131 E. 9th St., Elmira Heights, N.Y.

CIRCLE INFORM-A-GRAM KEY NO. 2012

new BOICE dial snap gage

REDUCES OPERATOR FATIGUE



BOICE Dial Snap Gage size 0" - 1"

The BOICE Dial Snap Gage has been carefully designed for optimum balance and legibility with operator fatigue an uppermost consideration. The gage is available in sizes 0" to 4" each with a 1" range. It can be supplied with a selection of indicators.

Write for Bulletin 6B

BOICE MANUFACTURING COMPANY, INC.
STAATSBURG, NEW YORK
DIAL GAGES BY BOICE "INDICATES QUALITY"

CIRCLE INFORM-A-GRAM KEY NO. 2013

ELASTICONE® GUIDE PIN COVERS

CUT DIE COSTS 25%

Low-costing Elasticone Guide Pin Covers reduce die breakage; protect man & machine — closes the gap between pins and bushings.

Just snaps into place—no installation costs. Manufactured in stock sizes.

Write for full information and literature.

CENTRAL

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CENTRAL SAFETY EQUIPMENT COMPANY

CIRCLE INFORM-A-GRAM KEY NO. 2014

CARBIDE, STEEL, SAPPHIRE

MIRROR-FINISH GRINDING

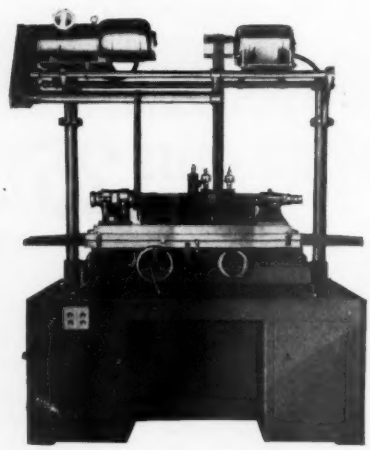
to Close Tolerances

SURFACE GRINDER

Model No. 612

Grinds 6" x 12" — by 15" height over Standard chuck with 8" wheel.

Available with either Double Taper or Ball Bearing designed Spindles.



No. 1018

UNIVERSAL GRINDER

10" Swing, 18" Center Distance
10" Wheel — Cabinet Style Mounting

New opposed double taper Headstock bearings, roundness from .000005" to .000010".

WRITE FOR LITERATURE

CRYSTAL LAKE GRINDERS

Since 1910

Crystal Lake, Illinois

CIRCLE INFORM-A-GRAM KEY NO. 2021

TEST HARDNESS OF ANY SIZE, SHAPE, TYPE METAL . . .

anywhere . . . in one easy motion!

This 30 oz., 3 in. high tester, in 30 seconds, gives direct dial readings on the job. Just press handgrips, read dial.

Accuracy guaranteed by individual calibration. Available in Newage Scales corresponding to:

Rockwell "A" 35-75 Scale	Rockwell "15N" 70-95 Scale
Rockwell "B" 5-100 Scale	Brinell Medium 100-440 Scale
Rockwell "C" 6-70 Scale	Brinell Low 50-260 Scale

Write today for Booklet ET 625 or demonstration in your shop.

NEWAGE INTERNATIONAL

portable metal hardness testers

ERNST PATENT #2536632. MADE IN U.S.A.

NEWAGE INTERNATIONAL, INC., 235 E. 42 ST., NEW YORK, N.Y.
TORONTO 14, ONTARIO: 3 Bestobell Rd., Queen Elizabeth Way

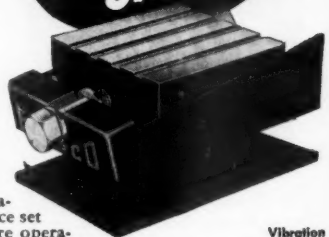
Distributors' Inquiries Invited!

CIRCLE INFORM-A-GRAM KEY NO. 2022

Here's how to SAVE TIME in SETTING-UP and KEEPING your MACHINES LEVEL

Fast Accurate Self-Aligning Machine Leveler

Empco JACK



Empco Jacks enable you to meet hurry-up demands for relocation of machinery by giving you the fastest, easiest, most accurate machine leveling ever known: you simply raise or tilt machine sufficiently to allow the Empco Jacks to be slipped under base. The number of jacks required depends on weight of machine and size of base. Once set on Empco Jacks, the entire operation of leveling and maintaining equipment level is quickly done. By applying a wrench to the "hex" head of adjusting screw, an adjustment is obtained either up or down until your level indicator reads "zero." Write for specifications and prices today.

Vibration absorbing mounting pads increase machinery life.

EMPCO PRODUCTS

THE ENTERPRISE MACHINE PARTS CORPORATION

2735 JEROME AVENUE • DETROIT 12, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 2023

. . . Magnetic Comparator, from page 200

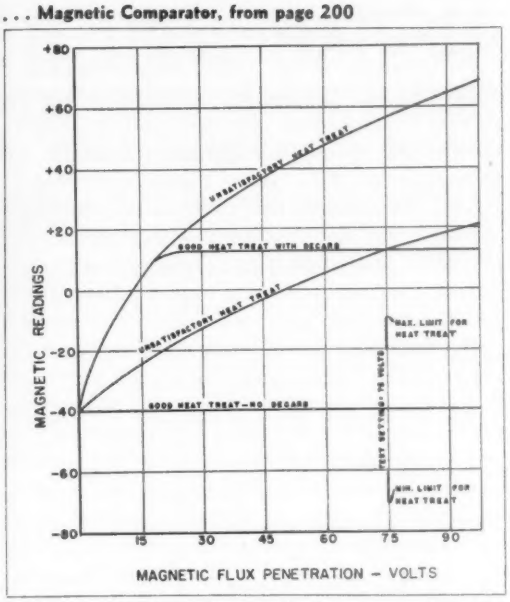


Fig. 5. Varying of magnetic flux penetration to determine decarburization.

about 0.075", the decarburized surface will affect the test out of all proportion to the percentage of the total mass which it represents. A small amount of decarburization may therefore confuse the picture and cause rejection.

Ordinarily, in checking the heat treatment, we apply 75 volts to obtain sufficient depth of testing. If the reading falls outside the permissible limits and we suspect decarburization, we again use the magnetic comparator, this time in a different manner. By varying our voltage we get magnetic readings on the surface of the case and then penetrate by degrees into the sidewall. By studying the pattern the magnetic readings assume as we increase the effective depth of testing, we can determine the cause of the high magnetic readings obtained on our routine test setup. Figure 5 illustrates the way we interpret the results. The abscissa indicates the magnetic flux penetration, or effective depth of testing. The ordinate indicates the degree of magnetic properties.

A case with a good heat treatment and no decarburization will give consistent magnetic properties as we penetrate from the outside in. A case with a good heat treatment but with decarburization will show progressively higher magnetic properties until we pass beyond the depth of decarburization, and will then level off to give consistent readings. A poorly heat treated case will give continually higher magnetic readings as penetration is increased. By such testing we can determine whether a rejection was caused by decarburization. If so, by analyzing the curves we can even determine the approximate depth of such decarburization.

Tempering of the Heat Treated Structure

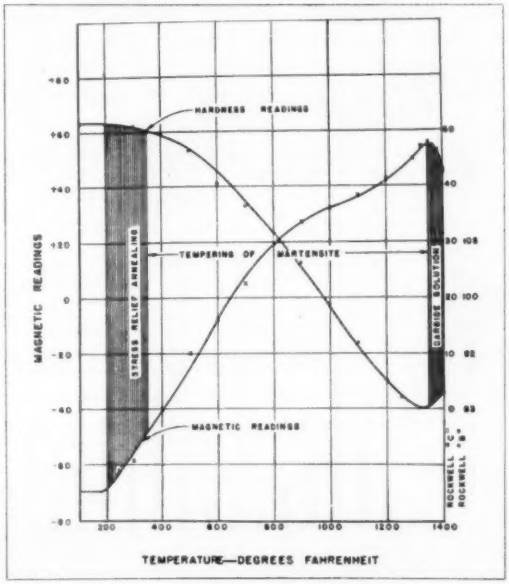
After we obtain satisfactory hardening through heat treating, we cannot leave the metal in this condition. A quenched structure is very poor in impact properties and must be drawn back. The higher the temperature at which we temper, the more we will improve the toughness of the steel. Unfortunately, however, the higher tempering temperature will effect a gradual decrease in hardness (. . . and the important yield strength and tensile strength characteristics, which go hand in hand with hardness).

It is necessary, therefore, to apply a compromise temperature which will give the case a satisfactory combination of impact and hardness properties. The optimum temperature will cover a narrow range, ordinarily 660-710° F. Any deviation toward the low side will sacrifice one property, and toward the high side another. With as critical a treatment as this, elaborate controls and safeguards must be placed on oven operation. This we accomplish with limit switches and warning bells which assure shutdown of the equipment until the trouble has been located and corrected. Even so, we are faced with the question of the condition of the cartridge cases caught inside an erratic oven. Here again magnetic testing is put to use.

We have observed that with an increase in effectiveness of heat treatment the magnetic

. . . *Continued on page 204*

Fig. 6. Effect of varying temperature upon the hardness and magnetic characteristics of heat-treated SAE 1030 steel.



. . . Magnetic Comparator, from page 203

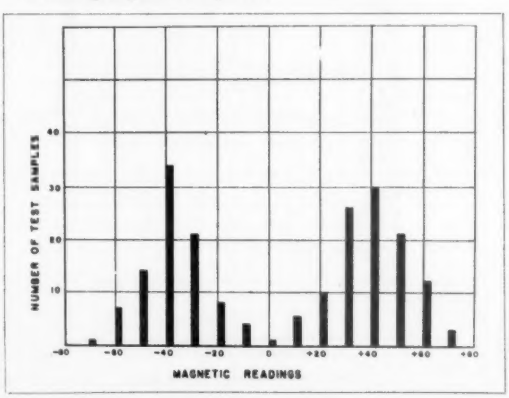
properties decrease. With an increase in the effectiveness of tempering, on the other hand, these properties increase. As the steel is converted from a martensitic structure to tempered martensite, then on to troostite and sorbite, it becomes more and more magnetic. The effect of tempering is shown in Figure 6. From this illustration it is obvious that a magnetic check can tell us not only whether tempering has been carried out, but also the degree of such tempering. The check is more accurate than that of hardness when working within such a narrow hardness range; and with each magnetic reading involving only a few seconds of time, it is a simple matter, when warranted, to check entire oven loads of cases.

Stress Relief Annealing

Stress relief annealing is generally applied to the finish-formed cartridge case just prior to coating with protective varnish. This anneal relieves stresses induced by the cold-working operations. On a cartridge case which has not been heat treated, but depends solely upon cold working for its strength, this operation assumes even greater importance.

The anneal is applied within a range (usually 650 to 750° F) which actually adds some 10,000 psi to the yield strength of the cold-worked steel. Where cold-work strength is a consideration on any portion of the case, the safety factor provided by this increase is vital. As a result, we must have adequate control over the stress relief anneal operation, and a satisfactory means of troubleshooting. Hardness will increase two or three points Rockwell B as a result of stress relief anneal. If the case is not cut open, however, we can obtain this much variation during testing because of the tapered outside dimensions and the thin-walled-tube effect. We could check yield strength or residual stresses, but such tests are destructive and time-consuming.

Fig. 7. "Double-curve" distribution indicating two distant groups of test pieces.



Fortunately, stress relief annealing has a very great effect upon the magnetic properties of cold-worked steel. By re-examining Figure 3, we can see how magnetic properties increase as the stress relief anneal temperature rises. As stresses are reduced, conductivity through the steel apparently increases. The magnetic characteristics therefore readily indicate whether or not the case has been stress relief annealed, and even to what extent.

By working within only the stress relief range of the magnetic curve shown in Figure 3, and by increasing the sensitivity of the magnetic comparator to extend this range over the entire readable scale (—100 to +100), we can obtain still greater accuracy and better interpretation of magnetic effects. An analysis of such readings can even serve as a check on the operation of an oven and determine the accuracy of the oven control instruments.

Identification of Heats of Steel

Heats of steel can be sorted by magnetic testing when they show variation to any reasonable extent in a property affecting the magnetic readings. As an example, a heat of steel was put into our production line which later was found to have a .36% carbon content. Since government specifications very strictly limit the carbon content to .35%, it was important that every piece of steel be segregated which could possibly exceed this maximum. At that time the heat had already been mixed with a preceding heat of steel checking at .30% C.

A point in the production line was selected at which every piece could be magnetically checked. The distribution of readings obtained by sampling 200 pieces is illustrated in Figure 7. There are two distinct "curves". This unusual double-curve effect could mean only the existence of two different steels, or the application of two distinctly different methods of production. Since we knew our production methods could not possibly have varied to such an extent at the point of testing, it was obvious that two heats of steel, with two different carbon contents, were indicated. The higher carbon would be at the negative end of the magnetic range, and the lower carbon at the positive. The heats were sorted 100% on the basis of the two curves. The pieces representing the unacceptable (high carbon) curve were rejected. The remaining pieces were then sampled by ordnance inspectors and the samples analyzed for carbon content. No carbon checks were found above .32%, and the lot was considered acceptable.

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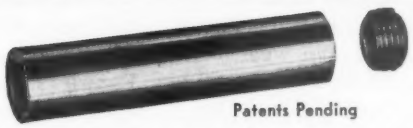

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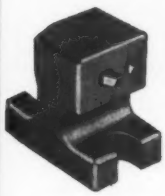

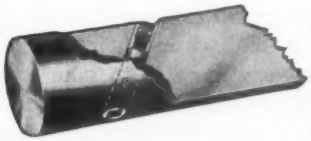

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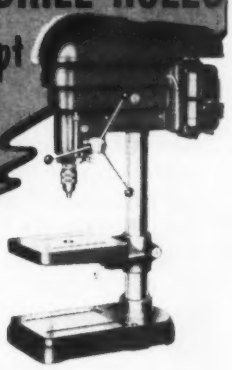

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. . . Quality Capability, from page 88

charts and the necessary action that had to be taken when the chart showed out of control conditions.

Taking Full Advantage of Tolerance — Modified Limits

Now, if we continued to control this dimension from approximately 1.0 to 4.0, the reader might advance the logical question, "Would we not be removing part of the specification from the job since the blueprint limits are 0 to 5?" Yes, we would be doing that. However, once we had assured ourselves that we did have trained personnel who could work with the charts and take the action indicated by the charts, we removed these tight control limits. and substituted others called modified limits.

These modified limits are based on the capability study of the machine and are calculated so that the $\bar{X}$ points can range within the specification to the modified limits which prevent individual pieces from going out of specification. These limits are calculated as follows (again referring to Datum Dimension A, Spindle No. 1):

Upper modified limit for $\bar{X}$ ($UML\bar{X}$)

$UML\bar{X}$ = Upper spec. — $M\bar{R}$

Upper spec. = 5

$\bar{R}$ = 1.2

M = .71 (a constant obtained from reference #5, page 809)

$UML\bar{X}$ = 4.15

Lower modified limit for $\bar{X}$ ($LML\bar{X}$)

$LM\bar{X}$ = Lower spec. + $M\bar{R}$

Lower spec. = 0

$LML\bar{X}$ = .85

Note that these modified limits (.85-4.15) are considerably wider than the first control limits (1.8-3.2) which held the process to the specification mean. This allows the process to roam within the specification but to be stopped by these modified limits before trouble occurs. These limits, however, are not as wide as specification limits and the almost universal reaction that newcomers to Quality Control have is that we are still removing part of the tolerance.

If one will realize that these limits are for averages and not individual measurements, one would see that if an average of five pieces ($\bar{X}$) is at the modified limit, there must be some individual measurements between the modified limit and the specification.

The modified limits are calculated so that there is little chance for an individual part to be out of specification. Our Figure 12 has both the control limits and the modified limits which were established later.

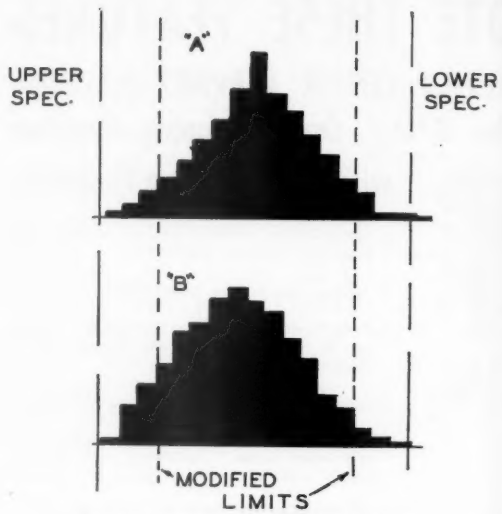

Fig. 15. Control with Modified Limits

Range Chart

Note that the limits of the R chart have never changed from the time of the capability study thru the modified limit time cycle. It is this fact that gives us our basic assurance that the machine has a capability which we have proved thru calculations and actual experience with the machine when control charts are established.

Allowing for Tool Wear

The modified limit allowed us to take full advantage of our specification and the characteristics of tool wear. Note that when the modified limits were established, Figure 12, the job-setter was trained to set his tool at the low limit and the tool wear characteristics of the machine gradually caused the $\bar{X}$ points to rise until they reached the high limit. The job-setter then reset to the low limit again and the machine was allowed to run without interference until the high limit was reached again.

Further Verification of Control

Our 100% inspection, Figure 15, indicated that we were able to take full advantage of the specification but still maintain our controls so that only an extremely small amount of parts was out of specification (less than 0.1%).

This dimension has continued to show the same sort of controlled variation as shown by these charts. The studies were extended to other machines in the area and gradually each of these was brought into control.

. . . Continued on page 208

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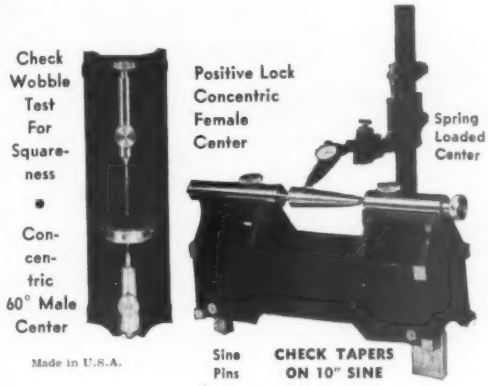

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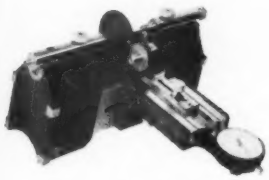

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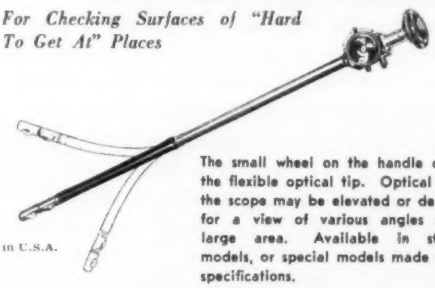

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CIRCLE INFORM-A-GRAM KEY NO. 2071

. . . Quality Capability, from page 206

Simplifying the Chart — The Group $\bar{X}$ and R Chart

The reader may have asked the question, "Six spindles, six charts?" Yes, at the beginning, to train the people involved we established separate charts for each spindle, but as time went on we simplified the procedure by the use of another type of $\bar{X}$ and R chart called the Group $\bar{X}$ and R chart. This chart enables us to record all spindles on one chart in this fashion.

Data is taken on each spindle, as before, but only the maximum $\bar{X}$ of the six spindles is plotted on the chart. Similarly only the minimum $\bar{X}$ is plotted as well as the maximum and minimum R's. The maximum $\bar{X}$'s are connected with a line as are the minimum $\bar{X}$'s and the maximum and minimum R's.

These maximum and minimum lines give the complete story on the machine as to the control that is being held since all other points must remain between these lines. Further information is available as to what spindle has caused the maximum or minimum point by placing the code number of the spindle at the particular point. Should any specific spindle indicate consistent maxima on either $\bar{X}$ or R chart, we would immediately go to that spindle to look for trouble. A much more complete analysis of this type of chart can be obtained in the excellent article by Boyd as referenced.

Additional Savings Thru Quality Capability Analysis

About this time it was decided to investigate the practice of annealing the forgings which were machined in this operation. Some time in the past annealing had been included in the job because it was felt that unannealed forgings were too variable to be controlled dimensionally at this operation and that this factor was significant in the inability to control the machining operation. A capability analysis was conducted using forgings which were not annealed and these showed no significant change from the capability analysis presented here. Therefore the expensive annealing operation was removed.

Inspection Savings

The 100% inspection in this area was discontinued when sufficient evidence was noted in the results of 100% inspection to assure that the charts were in fact effectively preventing out of specification parts. The original 18 inspectors were replaced by three process inspectors (one per shift) who merely plotted the charts. No 100% inspection on this characteristic is presently being used.

Sample inspections continue to indicate that the charts are effectively controlling this operation and the customer has not noted any increase in defective parts received at his plant. In fact, no complaints on this characteristic have been received from this customer since the installation of these Quality Control procedures.

Results: $60,000.00 Saved Plus Improved Management

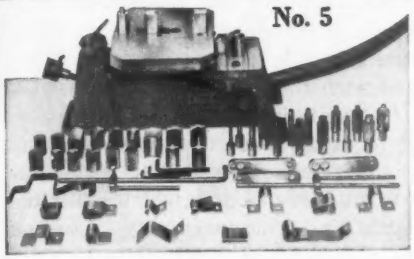
The results of the quality capability analysis and the application of control charts have been as follows:

1. In excess of $60,000.00 was saved on this purchase contract alone.
2. Scrap and rework on this operation dropped from 5% to less than 0.1%.
3. The 100% inspection was discontinued and substituted by one process inspector on each shift. Results: three inspectors effectively replacing 18.
4. The expensive annealing operations on the forgings were discontinued.
5. Down time was reduced sharply to a small fraction of the former delays. Where it was the practice to formerly adjust frequently each hour, since establishing the charts adjustments are usually necessary only once or twice each shift.
6. Production schedules which were formerly hard to meet are now met with ease.
7. Tools are reground with much less frequency, resulting in a considerable savings in tooling cost.
8. The morale of the production and inspection departments and the cooperation between all the departments improved significantly—a goal desired by all management.
9. Good outgoing quality is being obtained without the prohibitive cost of 100% inspection and the customer complaints have decreased.

CASE HISTORY NO. 2 — A Hopeless Case

When the author was called upon to study this machine, he found an 8-spindle automatic which had been purchased secondhand during the machine tool shortage. An outside diameter was being turned on this operation and the company was experiencing considerable difficulty in meeting a tolerance of 10 thou-

. . . Continued on page 210



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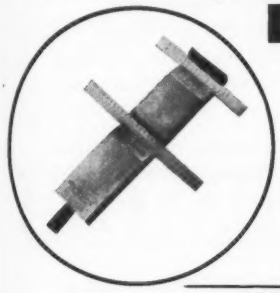

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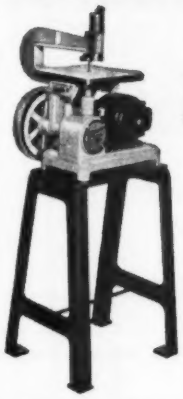

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. . . Quality Capability, from page 208

sandths. It seemed inconceivable that the machine was not capable of maintaining this tolerance but the quality capability analysis proved that this was the case. For purposes of brevity we will merely show the characteristic of one typical spindle, Figure 16.

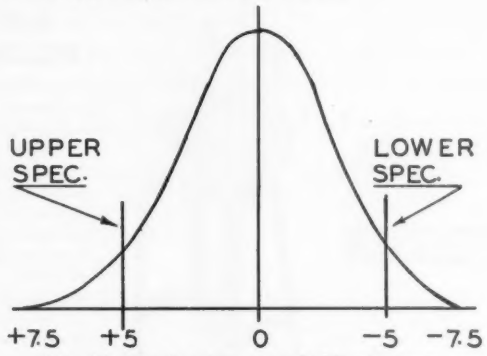

Fig. 16. The hopeless case; lacking in capability.

This spindle indicated that at best it could control to within approximately 15 thousandths and if centered as shown in Figure 16, would still produce 3.6% of parts out of specification with no allowance for the inevitable shift in average measurement due to tool wear and inability to perfectly adjust to center. Indications were that even if all spindles were adjusted to center, approximately 3.0% would be out of specification.

Complicating the matter, however, was a badly out of control range which indicated that our capability calculations were at best doubtful and an even worse situation would be experienced from this machine. This out of control range indicated a basic fault in the machine. Investigation of this basic fault indicated considerable maintenance cost to bring the machine into line.

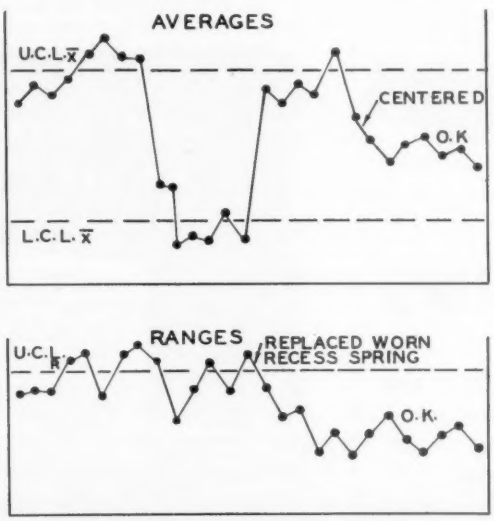

Fig. 17. The $\bar{X}$ and R chart for Case History No. 3.

Presented with these facts and further evidence of frequent down time, tool breakage and other troubles concerned with this machine, the management decided to move this operation to another machine which exhibited a good capability. This machine was turned over to the maintenance department for decision whether to completely rebuild or dispose of the machine. It was not to be turned over to production again unless a capability analysis had proved its characteristics had changed.

CASE HISTORY NO. 3 — Not So Hopeless

In this case a recess was being cut in the part. A quality capability analysis noted a consistent failure of the Range to stay in control on this operation. Figure 17 indicates the $\bar{X}$ and R chart which was established on this operation. Note that the Range was badly out of control, and that the average showed the results of constant adjustments of the machine since average points were also out of control. Maintenance was called in and after a study it was determined that the springs in the recess holder were defective and these had to be replaced. Note the controlled range as a result of this action and also note the control on the $\bar{X}$ and R chart. Difficulties in meeting specification on this operation disappeared and the machine has continued to perform as predicted in the original capability study.

Applications Unlimited

These cases are only three examples of the usefulness of the quality capability analysis technique. Quality control engineers all over the country report countless variations on the same theme—problems encountered and problems solved by these methods. The methods are universal and effective use of quality capability analysis has been reported in all fields.

Perhaps some readers may be struck by the thought that the tooling, machining or process problems that they are encountering are different and will not lend themselves to this kind of analysis. The quality control engineer does not take this view since experience in countless industries and innumerable types of problems have in fact proved this technique universal and its applications almost unlimited.

Management Uses of Quality Capability Analysis

In the foregoing case histories we have shown how quality capability analysis can help to correct a machine or indicate its satisfactory

. . . Continued on page 212

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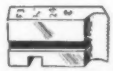

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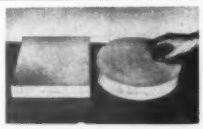

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. . . Quality Capability, from page 210

quality performance. There are, however, many other management problems which quality capability analysis methods can be applied to, in order to make intelligent decisions. Some areas in which this is effectively working are as follows:

1. Purchaser—Consumer Relations. A rapid development which has begun to have an impact on the purchaser-consumer relation concerning the purchasing of tools is the testing of these tools on the basis of a quality capability analysis. New tools, equipment and machines are being accepted or rejected in ever-increasing frequency by the results of a quality capability analysis. Some companies are beginning to insert clauses in their purchase contracts in which they state that the machine must show its ability to control variation on certain characteristics, under certain enumerated shop conditions, according to a quality capability analysis. On the other hand, an increasing number of organizations producing tools are using these studies intelligently to determine what kinds of dimensional control they can claim for their product. This phase of quality capability analysis will certainly expand as more and more tooling buyers insist upon factual information concerning tool performance.

2. Maintenance Decisions. Quality capability analysis is being used extensively to determine the economic maintenance cycle of machinery. Companies with preventative maintenance programs are leaning more and more on this type of analysis to provide them with information concerning the losses due to scrap, rework and the inevitable loss of quality reputation in the customer's mind. With these facts at hand more intelligent decisions can be made concerning the economic value of either running the machine or shutting down for maintenance. These studies also are being correlated with breakdown frequency records and are another factor to be considered in maintenance programs. Often these studies point not only to the time for machinery maintenance but in some cases show that the only logical decision is to scrap the machine, or completely rebuild it.

3. Determining Realistic Specifications with Quality Capability Analysis. All too often dimensional specifications are determined by designers with highly questionable methods. Often established practice may be no more than the result of years of habit in engineering departments. Yet after the specifications are placed on the drawing, they become an industrial law which in many cases plagues the producer. Quality capability analysis is proving day after day that many of these specifications are so unrealistic that they cannot be met by existing machinery or machinery which can be purchased.

This inevitably will focus the inquiring eye on the original specification and poses the logical question: "Why is that narrow tolerance necessary?" More often than not the design engineer cannot justify his tight tolerances in the light of the facts shown by the quality capability analysis of a tool in an excellent state of repair and maintenance. It then, of course, becomes logical to change the specification to something that can be maintained by good commercial tooling as shown by a quality capability analysis.

In this manner quality capability analyses are being used extensively to help determine realistic specifications. In ever increasing numbers designers are turning to analyses of present processes and equipment to help them in their design decisions. This certainly helps future production in removing the cause of many a quality problem—the unrealistic, uneconomical, unnecessarily tight design tolerance.

There are many cases where the designer does have sufficient reason to insist upon this tight tolerance. For example, strength or safety considerations may show the need for extremely small variation in a certain dimension. On the other hand, a quality capability analysis may indicate clearly that no commercial machinery available will perform as close as this tolerance demands. This would call for a decision that could resolve itself in two ways:

(a) The part would have to be subject to a rigid 100% inspection to remove out of tolerance parts since the machine is not capable of maintaining this tight tolerance and none can be purchased which can do this. Of course, this is a highly expensive method of getting the desired end and 100% inspection is always subject to errors and fatigue and certain percentages of parts will invariably be missed.

(b) The usual logical decision that the writer has found has been made most of the time is that the designer seeks an alternate design which would not require the rigid dimensional control demanded by the present design.

4. Research and Development Directions. Quality capability analysis not only brings to light the capabilities of tooling but often indicates inadequacies which are industry-wide. More often than not they present the facts which indicate a definite need for improvement

. . . *Continued on page 214*

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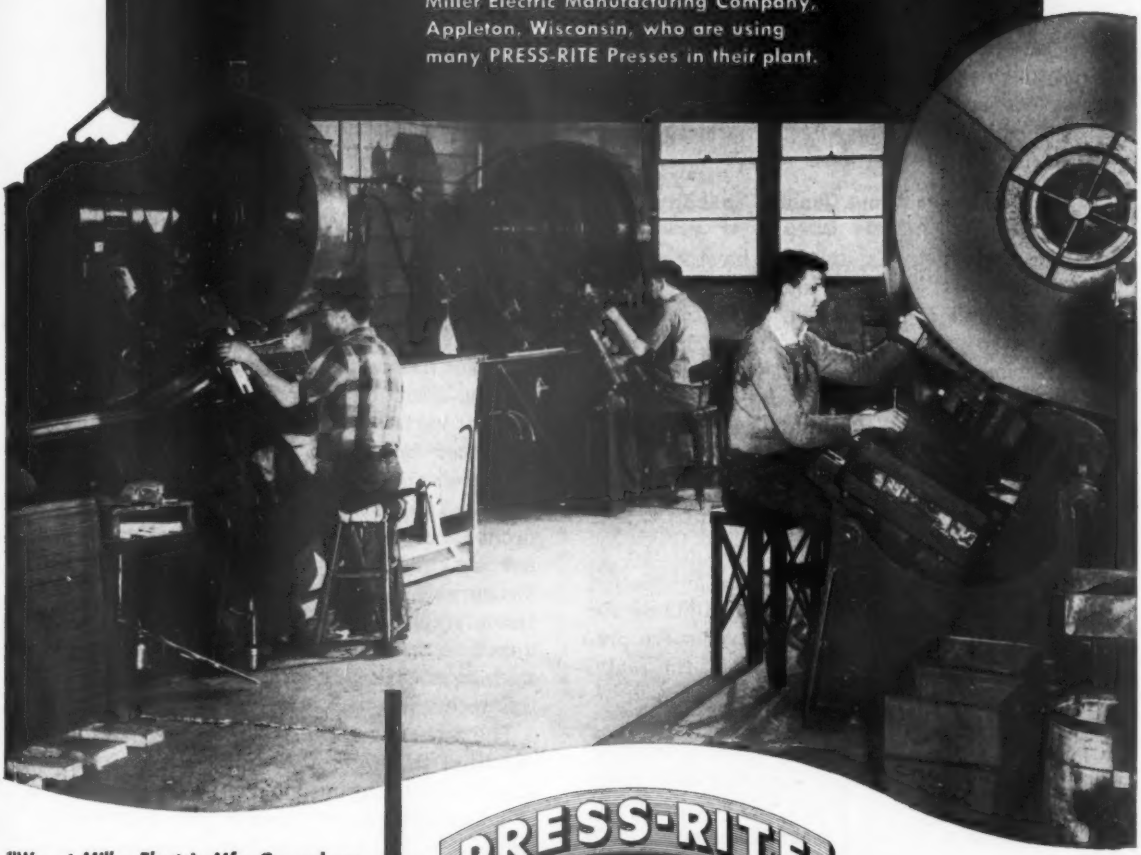

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. . . Quality Capability, from page 212

in design and performance of tooling as far as the ability to control dimensions is concerned. When faced with these findings, many tool producing companies have provided the answer by throwing their research and development staffs into the problem and through cooperation with the company seeking the needed improvement, have provided the answer to the needed improvements. As a commentary one might think about this effect on improved purchaser-customer relations.

Some Comments About Quality Capability Analysis

The case histories involved have been, for the most part, straight machining problems. For purposes of illustration, these are usually simpler to present for such an article as this. As has been previously stated, these techniques can be used to analyze the dimensional capabilities for any kind of tooling, equipment, production or process.

Quality Capability Analysis Not For Beginners!

The writer has attempted to present in straightforward fashion the background to quality capability analysis and its application to industrial problems. The calculations for the particular case history involved were presented to take this technique out of the realm of mumbo-jumbo for the reader.

The author, however, wishes strongly to point out that these techniques should not be the tool of the beginner. In order to present a new subject, many times it is necessary, as in this case, to present a simplified version of the science as a whole. In the hands of untrained personnel there is a strong possibility that many dangerous decisions can be made. Quality capability analysis is the tool of an experienced quality control engineer and the author cannot stress this too strongly.

Look Into Statistical Quality Control

Also, the author does not want to give the impression that these are the only techniques of statistical quality control. Actually, statistical quality control techniques are numerous and varied and those working in this science find every day that they are just scratching the surface and that the limitations of this science are not even predictable at present. Quality capability analysis was chosen for this presentation since it is of special interest to the tool producer and the tool user.

For the Experienced Reader

For the reader who is experienced in statistical quality control and quality capability analysis the author realizes that there is a controversy over whether consecutive pieces should be used for the entire quality capability analysis or merely five consecutive pieces taken periodically at the machine. In the case illustrated consecutive pieces were used but the author believes that the situation can demand either of these techniques and intelligent decisions can be made in either case. It is true that the second case (that of five consecutive pieces taken intermittently) does not give information on tool wear but in light of obtaining a "before and after" picture for proof of the extent of correction, it is felt that this method can be even more useful than the first.

Conclusions

One would logically conclude therefore that quality capability analysis is an effective management tool which can be applied to any production situation to determine not only what present variations in dimensions are being experienced but what variations in dimensions can be obtained through quality control procedures. Intelligent management decisions on production, maintenance, purchasing, engineering and many other areas can be aided immeasurably through the use of this technique. Innumerable instances have been recorded by quality control engineers showing considerable savings in costs and quality reputations using this technique.

The writer would predict without equivocation that the applications of these techniques as well as other proved and effective techniques of statistical quality control will continue to expand in an ever-increasing tempo in the American industrial scene. ◆ ◆ ◆

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NOTE

Editor's note: The first part of Mr. Bayer's article appeared in our May 1954 issue. We regret the circumstances that have caused such a lapse of time between our publication of the two parts. We will have a limited supply of reprints of "Quality Capability of Machine and Tools." If your May issue of TOOLING & PRODUCTION has become "lost, strayed or stolen" and you want a reprint of the article in its entirety we will endeavor to fill your request; one copy, and first come first served. —E. W. P.

. . . Gagemaker, from page 82

Floor inspectors? Quality control charts? Why? The operator must be capable of measuring his product or he could not make it. He is an honest man, he is proud of himself, his work, his product and his company. He doesn't need anyone to tell him he's made a good gage — he tells us.

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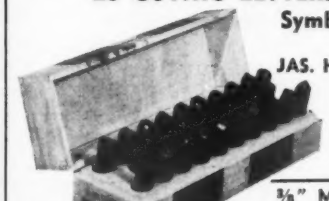

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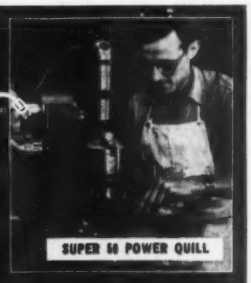

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. . . Steel Industry, from page 114

be mildly understanding but increasingly appreciative.

The successful development, growth and utilization of a Q.C. program requires something more than passive support. A minimum requirement could be stated to be positive backing; the ideal situation is aggressive direction. Steel management at executive, plant or department level has perhaps not yet reached this ideal stage to any important degree, but it is rapidly developing confidence in the abilities of its quality control people. It is for this reason that steel plant people with a broad background in plant operations and properly trained in quality control are essential to a sound program.

Confidence on the part of management in the ability and experience of the individual is absolutely vital. The selection and proper training of such people who are thoroughly familiar with "our plants, our people, our materials, our processes and products, our customers," will do much to develop that confidence. As appreciation for the breadth of application of these techniques increases, management is sure to avail itself of the potential. Management will always take advantage of a tool which helps to sharpen its own judgment.

Perhaps the most significant recent development in the steel industry is an action taken by the American Iron & Steel Institute. In recognition of the part being played in its industry by quality control, the Institute recently established a Committee on Product Standards. This committee consists of twelve men. Four of them are statisticians versed in the latest methods of collecting and analyzing statistics of all types, particularly where machine methods are involved, and eight of them are technical statisticians well versed in the technology of steel as well as in the latest statistical techniques involving quality control.

They will supplement and complement the work of the various technical committees of the Institute, lend their assistance wherever it is deemed necessary or advisable, and generally see to it that the technical statistical work of the Institute is performed in accord with the most modern analytical methods. At least one objective of this action is the proper development of standards, tolerances, etc., on a basis of the most modern scientific methods supplementing experience, as opposed to a basis of opinion and guesstimation.

Thus can quality control in the steel industry be said to have received more or less official recognition as a part of modern technology and management. Acceptance and utilization, slow to gather impetus, have finally broken through the curtain of resistance and can be expected to expand as rapidly as qualified personnel can be brought into the picture.

From here on, active management support plus consumer understanding and tolerance of the technical difficulties involved will be the biggest aids to sound program development. Actually a pioneer in the field of applying statistical procedures to operations, this industry's activities may not have been quite as obvious as in other industries and perhaps not as well documented or widely disseminated. They have been quietly at work just the same, and are playing an important part in helping to produce better steel at lower cost.

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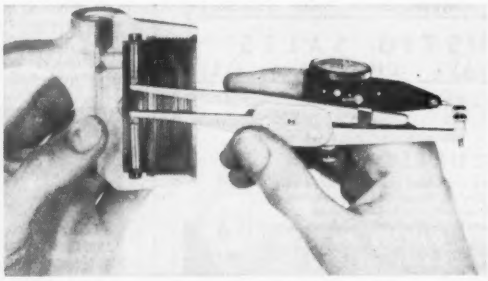

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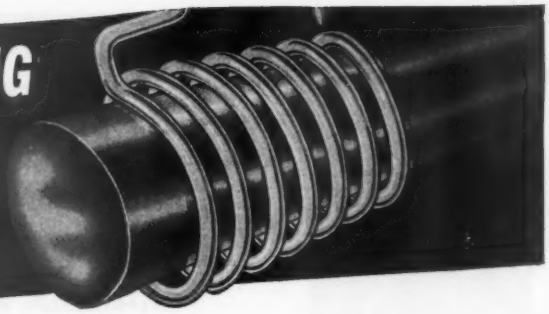

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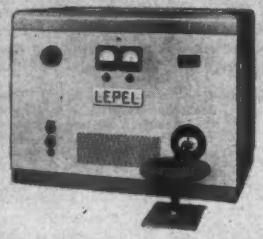

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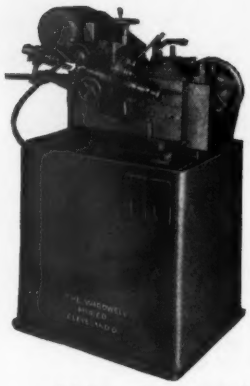

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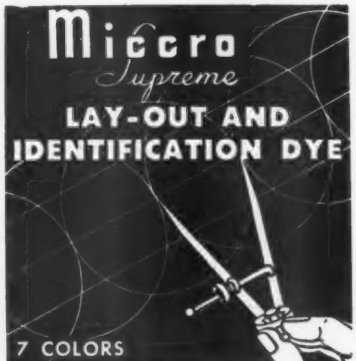

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"The metal treating industry, because its business is dependent upon the volume of most steel, aluminum, and other metal consuming manufacturing businesses, frequently is taken as a business barometer of the nation's economic welfare."

—From remarks made by Clifford M. Cook, president of the Metal Treating Institute.

"In the field of science and engineering, women have made remarkable strides, particularly in the last 10 years. . . . Today, women are valued members of research and engineering staffs, take their places frequently on the lecture platform at technical meetings, publish important papers, and win fellowships to carry on new lines of research."

—From Westinghouse Stockholders' Quarterly.

"By streamlining mill operations, by using more automatic equipment, by mechanical means of handling materials in mass production line methods, the textile industry is making very important strides in expanding its output potentials."

—From remarks made by Robert C. Jackson, Executive Vice President of the American Cotton Manufacturers Institute on the National Association of Manufacturers' "It's Your Business!" radio program.

"Extensive use of automation would act as a prod to our entire economy in three ways: first, by expanding the capital goods industry (building the automation devices); second, by enabling labor to increase its earning power (higher skills and greater productivity); and third, by reducing overall cost of production."

—By Del S. Harder, Vice President of Manufacturing, Ford Motor Company, at the recent Quad-City Conference on Automation in Davenport, Iowa.

"Unquestionably abusive grinding can damage a surface, but that is not sufficient reason for foregoing efficient stock removal, fine finishes, and dimensional accuracy which good grinding practice affords. One does not abstain permanently from food because overeating makes him ill. Instead, he practices moderation in order to enjoy good health. Much the same is true of grinding."

—From a paper entitled "A Modern Perspective of the Grinding Process," presented by H. R. Letner, Senior Fellow, Mellon Institute, to the Fall meeting of the American Society of Mechanical Engineers.

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SEE OTHER SIDE FOR PARTIAL LIST OF RECENT EDITORIAL FEATURE ARTICLES.

Here are some of the feature articles that have recently appeared in Tooling and Production.

"Producing Holes in Large Parts by Multiple Drilling Equipment"

"Standard Units and Air Feeds Speed Up Drilling and Tapping"

"Good Broach Design"

"Know Your High Velocity Band Tools"

"Diamond Sludge Recovery"

"How to Select Precision Switches"

"How to Run a Production Test of Metal Abrasives"

"Controlling Visual Characteristics on Precision Parts"

"Quality Level Certification"

"Quality Control of Involute Splines"

"Automatic Loaders for Crankshaft Lathes"

"An Unusual Dial Press Operation"

"Automatic Cycling of Machine Tool Operations"

"Electronic Production Control . . . As a Means to Cost Reduction"

"First Steps in Establishing a Statistical Quality Control Program"

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TRANSFER MACHINE IS GEARED FOR AUTOMATION

The development of a standard multiple-station transfer machine suitable for a wide variety of applications in industries converting to automation has been announced by The Ferguson Machine & Tool Co.

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The Trans-O-Mator contains a complete power transmission unit, including motor, reducer, clutch, Ferguson roller gear drive for high speed precision indexing, chain and carriers. There is an electrical interlock system between the indexing and the tooling power supply as well as start-stop and jog controls and provisions for an automatic scanning device to ensure proper function of all stations.

Type A is illustrated. Type B has a "caterpillar" track, with faces of carrier base plates on a horizontal plane as they progress the length of the machine.

For additional information, write to Roller Gear Division, Ferguson Machine & Tool Co., Box 191, St. Louis 21, Mo., or—**Circle Inform-A-Gram No. D7.**

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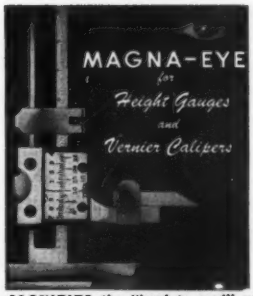

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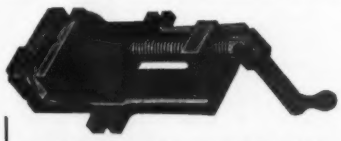

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. . . Air Power, from page 80

vary in amplitude the flow of air through the nozzle is varied accordingly. Were it not for the interposing of a mechanical gaging contact between the air nozzle and the peaks and valleys of a rough surface the air stream would split the difference between the peaks and valleys and come up with an unrealistic dimension. How unrealistic such a dimension could be in terms of diametral differences is given by Pratt & Whitney in their following comments on contact vs conventional air gaging:

"Contact gaging measures the dimension from the surface roughness peaks of the part being measured (A-A').

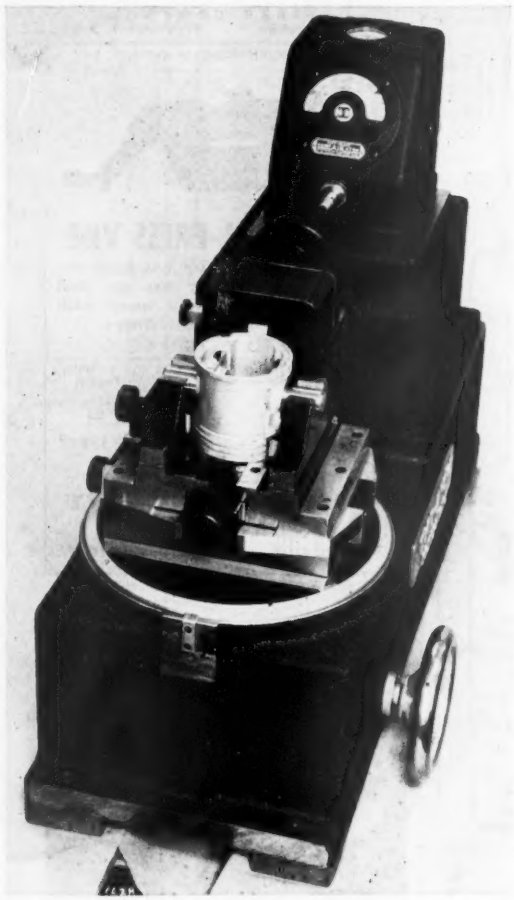

Photo courtesy Merz Engineering Company.

The Taft-Peirce Manufacturing Company designed and built this air-operated gage for a car manufacturer to measure the skirt contour of automotive pistons. The gaging fixture and centralizing table are mounted on an index table, graduated in 5-degree increments for 360 degrees. The tungsten carbide measuring contact is reed-mounted and adjustable to permit the inspection of pistons of various sizes. Magnification of the single dial CompAIRator is 415:1, with scale graduations of 0.0002". After the centralizing table has been adjusted to the piston size, the oval-shaped skirt contour can be checked for deviation at any radial point by rotating the index table.

"Conventional or open nozzle air gaging measures the dimension from the mean surface of the part being measured (B-B').

"The mean surface is approximately midway between the peaks and valleys of the surface. Technically, mean surface is defined as the imaginary surface which would result if all the peaks, ridges, and hollows of an actual surface were level or averaged to a zero value.

"This means that there is a difference between contact gage readings and open nozzle air gage readings. The amount of this difference obviously depends on the surface roughness.

"Surface roughness is generally specified in terms of R.M.S. values (root mean square). The accompanying table shows the calculated difference between contact gage readings and open nozzle gage readings for different degrees of surface roughness.

"In the case of comparing open nozzle air gaging with fixed gaging such as cylindrical plug, cylindrical ring, or plain limit snap gages, there are other factors besides surface roughness which influence the results of the different methods of gaging. Out of round and taper of an internal or external dimension could cause differences between plug gaging, for instance, and open nozzle air gaging which would far exceed the difference due to surface roughness only.

"All conditions of the part being gaged, therefore, must be correctly analyzed, if gaging medium differentials are being discussed."

The Taft-Peirce Manufacturing Company offers the following in reference to contact gaging:

"Quite often a part or dimension is produced which, due to its geometry or the roughness of the surface to be measured, does not lend itself well to direct air gaging. It is often possible in such cases to retain air gaging ease and accuracy by utilizing special gage members of the contact type. Air plug, ring, and snap gages all lend themselves readily to applications of this sort.

"Rough surfaces and interrupted bores are two outstanding contact applications. Contact type air gage members are recommended in checking parts with surface finishes beyond 50 microinches, rms, or wherever the section of the part to be gaged is of limited area which cannot be checked by having the air impinging directly against the part surface. Measurement of diameters of less than 1/32" in length and narrow shoulders are typical examples of contact applications.

"These members are usually designed with a tungsten carbide contact button mounted on

. . . Continued on page 222

BALANCING ROTATING PARTS

Defective bearings, electric motor torque pulses, and transformers can cause high frequency vibrations. Chatter and vibration in a machine tool will produce poor finish or rejects.

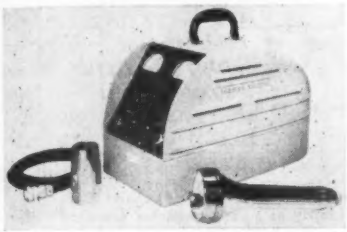

Photo courtesy International Research & Development Corp.

To analyze these machine defects, a portable electronic vibration analyzer, weighing only 24 lbs, has been developed. It is capable of balancing rotating parts at speeds up to 5,000 rpm and of tracing any vibration up to 20,000 cpm. It is designed to eliminate vibration in production machinery and to simplify maintenance of plant equipment through dynamic balance of rotating parts.

Balancing, with the aid of a stroboscopic lamp with a range up to 5,000 flashes per minute, is done through a short four-step procedure.

Analysis, particularly of such high frequency vibrations as those resulting from defective bearings, is accomplished through electronic frequency and displacement circuits which render data on panel meters.

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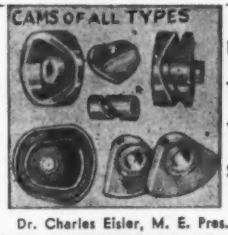

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. . . Air Power, from page 220

a reed-type spring and positioned directly over an air nozzle, thus retaining the self-positioning advantages of direct air gaging. The contact button or buttons engage the part surface and indications of size will be obtained according to the resulting clearance between the reference or back face of the contact button and the surface of the air nozzle."

* * *

Air gages can be built into production operations. Under the heading of "Machine Control with Plunjet Gaging Cartridges", The Sheffield Corporation offers the following example:

"The rapid development of high amplification comparators rugged enough for use at the machine is the result of the progressive closing in of tolerance limits.

"Teaming up the high amplification gage to the machine is a partial solution where parts are being produced to a "tenth" rather than a "thousandth". A more complete answer is to equip the machine operator with a means of comfortably staying within the tolerance zone or center of the process. This will enable him to produce a quality product with minimum scrap.

"This is now possible with the use of a Plunjet applied as the Sheffield Feed Gage which gives highly amplified accurate slide movement indication. Accuracy is attained regardless of inaccuracies due to feed screw wear. Actually, accuracy is increased on a brand new machine because of much higher amplification of the slide movement.

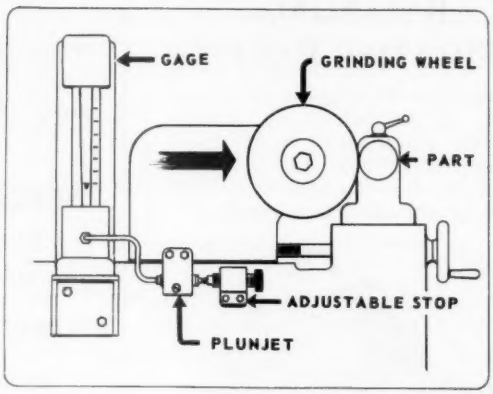

Photo courtesy The Sheffield Corporation.

Schematic arrangement of Plunjet cartridge and Precisionaire gage functioning as a feed gage for grinding machine.

"For example, in grinding shafts on an external grinder, the Plunjet is mounted on the wheel head slide so as to contact a fixed adjustable stop mounted on the stationary part of the machine. The Plunjet is connected to a Column Precisionaire Instrument mounted in any convenient location. The first shaft is ground and gaged on a comparator or Airsnap. The fixed adjustable stop is adjusted to position the float in the Precisionaire column according to the result found by gaging the shaft. The slide infeed wheel is manipulated until the float in the Precisionaire column is at "O", indicating the shaft diameter is of the desired size. All succeeding shafts are ground for "O" float position in the column. The comparator or Airsnap is used to check the shaft after grinding. When wheel wear is indicated by an oversize part, the fixed adjustable stop is adjusted accordingly.

"On production grinding, wheel wear is constant and with a little experience can be compensated for on this basis. A quality control sample plan can be instituted if desired. Actually, the feed gage is a unique method of applying a running quality control of machine tool performance.

"With the aid of the feed gage employing high amplification indicating slide movement, unskilled labor can produce parts ground to fine tolerances at an acceptable rate of production. This method of machine control is just as effective for the one-of-a-kind grinding job as for a production run. The high amplification indication of slide movement is the answer to removing the last tenth of stock easily.

. . . *Continued on page 225*

Photo courtesy Pratt & Whitney Division Niles-Bement-Pond Co.

This combination of a P & W Air-O-Limit snap gage, booster check valve and light signal control unit adds up to a centerless grinder gage. Pneumatic precision relays and electric pressure switches, sensitive to dimensional changes of a few millionths of an inch, trigger red and green limit lights for over and under size indication. In addition to giving the off-tolerance signal, the circuitry can be utilized to shut down or even provide impulses to control the machine. The photo-insert shows the setup on a centerless grinder, gaging through-feed ball bearing outer raceways.

MACHINE TOOL CONFERENCE TO BE HELD IN DETROIT

An attendance of 600 is expected at the Machine Tool Conference of the American Institute of Electrical Engineers at the Statler Hotel in Detroit on October 25-27.

The principal speaker, according to Kurt Tech, Chairman of the A.I.E.E. Sub-Committee on Machine Tools, is Mr. Kenneth MacFarland, Education Consultant to General Motors.

Among the many other prominent speakers in their fields are Ralph E. Cross, Executive Vice President of The Cross Company, who will talk on "Automation"; Norman Conrad, Ford Motor Company, on "Maintenance of the Automatic Machine"; J. Ducher, General Electric and H. E. Ankeney, Giddings & Lewis Machine Tool Company on "Record Play Back Control of a Hydro Skin Mill"; L. P. Randall, Turnstedt Division of General Motors on "Preventative Maintenance Systems"; M. M. Arlin, Arlin Products, Inc. on "Standard Automation and Inspection Equipment"; P. H. Allsbach, General Electric on "Automation Today"; J. H. Hosmer, Allis-Chalmers Co. on "Techniques in Failure Prevention"; and Dr. Henry Gomberg, Assistant Director of the University of Michigan Phoenix Project, on "Peacetime Applications of Atomic Energy."

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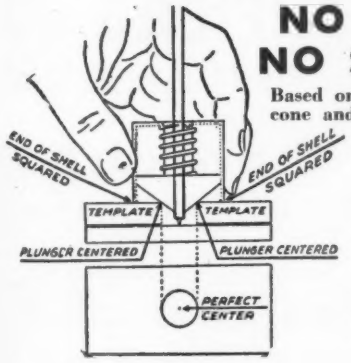

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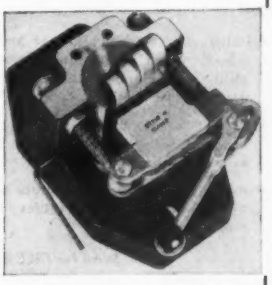

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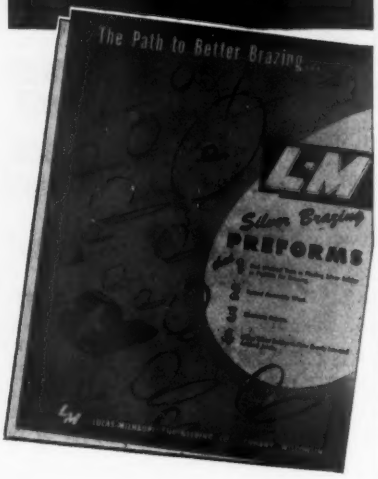

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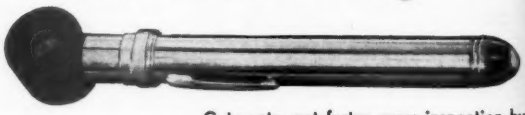

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. . . Air Power, from page 222

"Existing applications have proved the following advantages: rejects reduced, greater accuracy obtained, production increased, unskilled labor used on precision work, machine capabilities evaluated, inspection reduced, operator morale increased by simplification of his task, and machine performance improved.

"These advantages may be obtained in applying the feed gage to all external grinding or turning machines."

* * *

There are many instances where wide tolerance gaging is specified. This is accomplished by a variation of the contact gaging method. Taft-Peirce Manufacturing Company states the case for wide tolerance gaging thusly:

"A recent development in air gaging is the special contact device designed for checking wide tolerance ranges. Original designs of air contact gages were limited to a range of about .008", the same as that of the direct air jet type. Through a unique design, it is now possible to check tolerance ranges up to .125".

"Single reed mounting of the contact can be followed for tolerances below .015". Beyond this figure, the contact is usually mounted on parallel reed springs, or in some instances on an antifriction ball slide. Type of contact mounting will be dependent on the individual application.

"These special contact members for checking wide tolerances have greatly increased the scope of air gaging. In most cases suitable CompAIRator equipment can be designed to check any specific tolerance range from .0001" to .125". In the wide tolerance ranges, it is still possible to utilize the basic advantages of air gaging. There are no mechanical linkages; exact size is indicated; gaging can be accomplished in restricted areas; many dimensions can be checked simultaneously."

Photo courtesy Federal Products Corporation.

This attachment for grinder gages, called Arnoldair, makes it possible to use air gages to follow the grinding operation. The high magnification and flickerless pointer inherent in air gages make it easy for the operator to grind to specifications because he can see the workpiece size directly on the Federal Dimensionair dial.

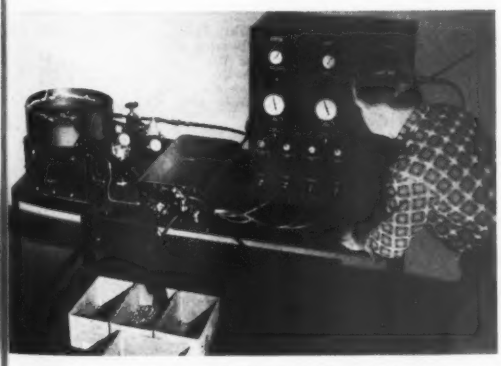

Photo courtesy Superior Steel Corporation.

An automatic sorting gage built by the Moore Products Company for the Superior Steel Corporation represents another step toward automation in the steel fabricating field. Measuring both the wall and base thickness of copper-clad bullet jacket cups, the actual gaging is done by Moore air gage nozzles. A system of pneumatic relays receives measurement signals amplified at 2700 to 1. These signals activate electrical sorting gates, and unacceptable cups are separated from those within tolerances. Data for quality control charting is read on the large scales which show actual dimensions of each piece.

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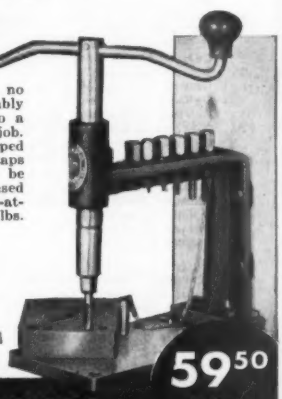

Winds through continuously, with no backoff. Work is always dependably straight and square. Fasten it to a post or set it on top of a big job. This handy tapper comes equipped with 9 adapters, 8-32 to ¾" but taps are not furnished. Spindle can be pulled out and used in a lathe, or used as tap extension for hard-to-get-at-places. 13" x 8" x 14", wt. 32 lbs. $59.50 F.O.B. factory.

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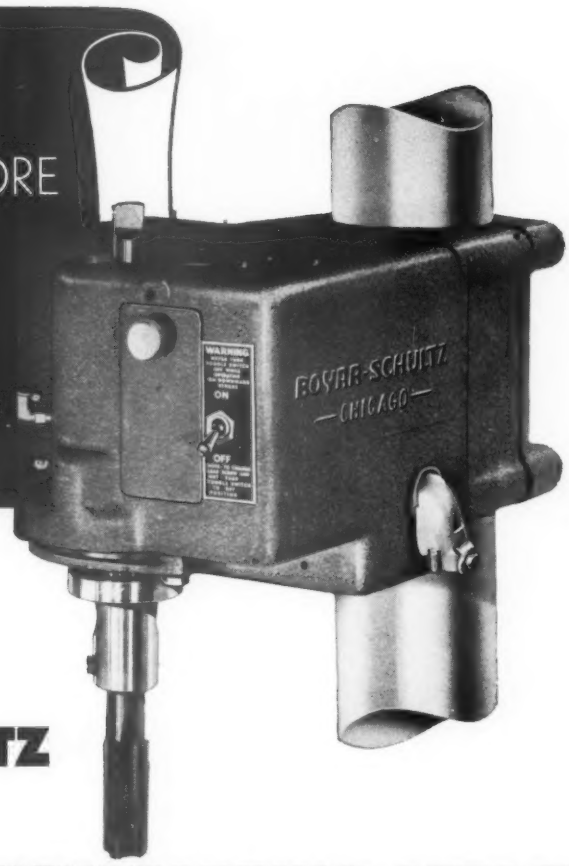

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